

SILICONE RUBBER

for wire and
cable application

SILICONE PRODUCTS DEPARTMENT

GENERAL  ELECTRIC

WATERFORD, NEW YORK

CONTENTS

FOREWORD AND INTRODUCTION	3
---------------------------------	---

ACKNOWLEDGEMENT	3
-----------------------	---

WHY SILICONE POLYMERS RESIST TEMPERATURE EXTREMES, OZONE, AGING	6
---	---

CHARACTERISTICS OF SILICONE RUBBER COMPOUNDS

Temperature Resistance.....	8
Radiation Resistance.....	10
Flame Resistance.....	11
Fire Resistance.....	11
Electrical Properties.....	12
Corona and Ozone Resistance.....	13
Chemical Resistance.....	13
Fungus Resistance.....	13
Weather Resistance.....	13
Inertness.....	14
Vacuum Performance.....	14

DATA AND CONSTRUCTION DETAILS — COMMERCIAL

Power Cable.....	16-18
Control Cable.....	19, 20

Apparatus Leads.....	21
Appliance and Fixture Wire.....	22
Heating Cable and Wire.....	23, 24
Commercial Ignition Cable	25
High Voltage Cable.....	26

DATA AND CONSTRUCTION DETAILS — MILITARY

Aircraft Wire.....	28
Hook-up Wire and Lead Wire.....	29
Navy Cables for Non-Flexing Service.....	30-32
High Tension Ignition Cable.....	33

SPECIFICATIONS

Commercial.....	26
Military.....	33, 34

PROPERTIES OF G-E SILICONE RUBBER COMPOUNDS

Coating Compounds.....	35
Wire and Cable Insulation.....	36

COMPOUND DATA	38
---------------------	----

FOREWORD AND INTRODUCTION

This publication is intended to assist you in the specification and application of silicone rubber-insulated wire and cable for the most reliable and economical service in your plant or equipment.

If your electrical distribution and control systems must operate under severe environmental conditions — if they are exposed to any or all of the hazards shown in the following check list, you should give careful consideration to the advantages offered by silicone rubber insulation.

- Heat
- Moisture
- Radiation
- High Ozone Concentration
- High Voltages
- Corona
- Arcing
- Low-temperature Flexing
- Corrosive Environment
- Fire
- Emergency Overloads
- Conduit and Duct Size Limitations

ACKNOWLEDGEMENT

Grateful acknowledgement is made for the helpful suggestions, guidance, and data received from the following wire and cable manufacturers in compiling this manual.

- **American Insulated Wire Corp.**
36 Freeman St.
Pawtucket, Rhode Island
- **American Super-Temperature Wires, Inc.**
112 West Canal Street
Winooski, Vermont
- **Belden Manufacturing Company**
4647 West Van Buren Street
Chicago, Illinois
- **Boston Insulated Wire & Cable Company**
65 Bay Street
Dorchester 25, Massachusetts
- **Collyer Insulated Wire Company**
100 Higginson Street
Lincoln, Rhode Island
- **Continental Wire Corporation**
322 North Cherry Street
Wallingford 2, Connecticut
- **Essex Wire Corporation**
Paranite Wire and Cable Division
Marion, Indiana
- **General Cable Corporation**
730 Third Avenue
New York, New York
- **General Electric Company**
Wire & Cable Department
1285 Boston Avenue
Bridgeport 2, Connecticut
- **ITT Wire & Cable Division**
122 Sterling Street
Clinton, Massachusetts
- **Kaiser Aluminum & Chemical Corporation**
Wire Division
Wood Street
Bristol, Rhode Island
- **NRA, Nuclear Research Associates**
35-01 Queens Boulevard
Long Island City, New York
- **Okonite Company**
1940 Canal Street
Passaic, New Jersey
- **Packard Electric Division**
General Motors Corporation
Dana Avenue
Warren, Ohio
- **Prestolite Wire and Cable Div.**
Eltra Corporation
Port Huron, Michigan
- **Reynolds Metals Company**
Front Street
Chester, Pennsylvania
- **Rockbestos Wire & Cable Company**
Division of Cerro Corporation
285 Nicoll Street
New Haven 4, Connecticut
- **Simplex Wire & Cable Company**
79 Sidney Street
Cambridge 39, Massachusetts
- **Springfield Wire & Tinsel Company**
70 Leete Street
Springfield, Massachusetts
- **U. S. Steel Corporation**
Worcester 7, Massachusetts
- **Wirekraft, Inc.**
Rolling Prairie, Indiana

SILICONE RUBBER OFFERS DISTINCT ADVANTAGES FOR WIRE AND CABLE INSULATION

The inherent characteristics of silicone rubber provide numerous advantages in electrical systems. Some of these, which are general and which have broad

implications, are shown in the following list. Others will occur to the user as specific applications are studied in detail.

CHARACTERISTICS

ADVANTAGES

HIGH TEMPERATURE OPERATION

- 125°C. conductor temperature power and control cable and generator leads
- 200°C. appliance and fixture wire

- Smaller conductors for a given load.
- Smaller overall size means smaller conduit required.
- Solves high ambient bottlenecks.
- Longer life in high ambient applications.

MOISTURE RESISTANCE

- Far superior to other available high-temperature power cable insulations

- No lead sheath required
- Cable is easier to handle and lighter in weight
- Eliminates sheath corrosion problems

FLEXIBILITY

- At high and low temperatures

- Does not get hard, brittle, or crack at high temperatures.
- Remains flexible at -55°C.
- Trains into position easily at termination points.
- Only one type of cable required for a broad range of temperatures.

CORONA RESISTANCE

- Easy splicing and terminating
- No stress cones required
(No shielding required up to 5 KV)
- Handles like any rubber-insulated cable
- No special tools or fittings required
- No specially trained crews required
- Reduces installation time and cost
- Complete line of splicing tapes compatible with high-temperature insulation is available
- Operation under hard vacuum without severe de-rating

CHARACTERISTICS

ADVANTAGES

OZONE AND SUNLIGHT RESISTANCE	● No protective coverings required on outdoor terminations ● Suitable for high-altitude and aerospace applications
RELIABILITY	● Maintains circuit continuity in fires (silicone rubber insulation burns to non-conducting ash — many other insulations burn to conducting carbon) ● Provides continuous operation for 20 years or more at rated temperature. ● Withstands high humidity, emergency overloads, and corrosive chemicals.
AVAILABLE IN WIDE RANGE OF SIZES AND VOLTAGES ● Voltage range 300 volts to 35 KV ● Conductor sizes up to 3000 MCM	● Wide selection to meet all of high-temperature requirements.
RADIATION RESISTANCE	● Permits use in nuclear reactor installations where high temperature ambient conditions combined with high radiation levels would rapidly destroy other insulating materials.
LIGHT-WEIGHT	● Low specific gravity (SE-9035=1.16) results in significant reduction in weight of wire and cable. This is of particular importance in missile-aerospace applications.
EXCELLENT ELECTRICAL CHARACTERISTICS	● High dielectric strength, unequalled resistance to dielectric fatigue, low power factor and low dielectric constant permit use in the most critical applications with assurance of long-term reliability.
HIGH THERMAL CONDUCTIVITY	● The high thermal conductivity of silicone rubber permits rapid dissipation of heat from the conductor to the ambient heat-sink. This results in lower cable operating temperature.

WHY SILICONE POLYMERS RESIST TEMPERATURE EXTREMES, OZONE, AGING

Chemically, silicones are quite different from all other materials. It is this difference which gives them their unique combination of properties — properties which permit silicones to perform in many applications where no other materials can be used.

The basic difference between silicone polymers and organic polymers is illustrated right. All organic polymers, such as natural rubber, are made up of a backbone of carbon-to-carbon atoms linked together as shown. Silicones, such as dimethyl polysiloxane, differ in that their backbone structure is made up of silicon-oxygen linkages. This silicon-oxygen linkage is the same bond that is found in other high temperature materials such as quartz, glass and sand, hence the outstanding high-temperature properties of silicones and their general inertness toward many deteriorating effects such as ozone, corona, weathering and radiation.

In addition, many organic polymers contain some degree of unsaturation where carbon atoms are joined together by double bonds. These double bonds are the site of attack by ozone, particularly at high altitudes. Because the silicone polymer contains no double bonds, it is extremely resistant to ozone even in extremely high concentrations and over very long periods of time.

The silicone molecule is built by the chemist to do the job required in a given application. Of the several organic side groups which can be used along the polymer chain,

COMPARATIVE PROPERTIES OF NATURAL AND SYNTHETIC RUBBERS

	Tensile Strength, psi Room Temperature	Tensile Strength, psi		Abrasion Resistance	Oil Resistance	Durometer Hardness Range	Specific Gravity of Base Elastomer
		250F	400F				
Silicone	800-1800	850	400	Good	Good	20-95	0.98
Natural	1500-4000	1800	125	Excellent	Poor	20-100	0.93
Styrene-Butadiene (SBR)	1500-4000	1200	170	Excellent	Poor	40-100	0.94
Butyl	700-1500	1000	350	Good	Poor	30-100	0.92
Nitrile	600-4200	700	130	Excellent	Extremely Good	30-100	1.00
Neoprene*	1500-4000	1500	180	Excellent	Very Good	20-90	1.23
Hypalon*	500-2800	500	200	Fair to Good	Good	50-95	1.10
Fluoroelastomers Kel-F**	2000-2700	300- 800	150- 300	Good	All Extremely Good	60-90	1.4 to 1.95
Viton-A & B*	2400						
Fluoro-Polyester	2000-2200						
Fluro-Acrylate	950-1250						

* T.M., E. I. duPont De Nemours and Co., Inc. ** Minnesota Mining and Mfg. Co.

IMPORTANT

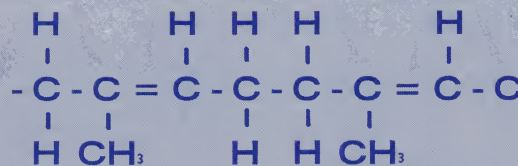
One of the most important advantages of silicone rubber insulating materials is that they can be tailored, through the use of different fillers and additives, to do a wide variety of jobs. By the judicious selection of ingredients, it is possible to emphasize the characteristics needed in

a particular application, such as extreme low temperature flexibility, extreme heat resistance, optimum radiation resistance, flame resistance, and many other benefits. In the discussion of the physical and electrical properties of silicone rubber compounds on the following pages, the materials have been identified wherever the

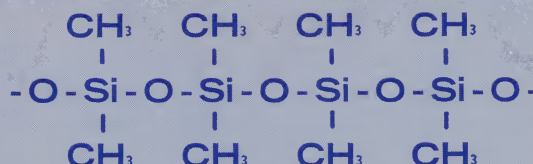
methyl, phenyl and vinyl are employed most often — with methyl the most frequent of these.

By replacing some of the methyl groups with phenyl groups, several properties may be improved. Silicone rubber compounds which retain their flexibility to temperatures of -150F and below all contain phenyl groups. The addition of phenyl groups also improves the radiation resistance of silicone rubber. The addition of vinyl side groups improves the vulcanization characteristics and the compression set resistance of the cured rubber. While in organic rubber the double bond of the vinyl group is the site of ozone attack, in silicone rubber the double bond is neutralized during vulcanization so that ozone resistance is retained.

Basically, a silicone rubber compound consists of a quantity of silicone polymer mixed together with one or more suitable inorganic reinforcing fillers and a vulcanizing agent. Other ingredients sometimes included are color pigments and various additives used to modify processing characteristics or cured properties. Properly chosen fillers will increase physical properties and improve heat resistance, electrical properties and chemical resistance, as well as affect modulus and hardness.



ORGANIC POLYMER
Natural Rubber



SILICONE POLYMER
Dimethyl Polysiloxane

	Maximum Service Temp., °F	Minimum Service Temp., °F		Resistance to 150 ppm Ozone at Room Temp. Under Stress	Elongation %, at Room Temp.	Elongation %		Tear Resistance #/in. at Room Temp.	Service Life at 300F In Dry Air
		Static	Dynamic			250F	400F		
	500 (+)	-150	-100	Beyond 2 Weeks	100-800	350	200	40 to 250	Continuous
	240	- 50	- 30	Fails Immed.	700	500	80	300	Fails Rapidly
	200	- 55	- 40	Fails Immed.	300-700	250	60	—	Fails Rapidly
	200	- 70	- 60	7 Days	500-700	250	80	To 500	Fails Rapidly
	250	- 68	5	1 Hour	400-600	120	20	7 to 40	Fails Rapidly
	250	- 65	- 40	24 Hours	60-700	350	0-100	300	Fails Rapidly
	250	- 68	0	Beyond 2 Weeks	300-500	60	20	—	9 Days
	400	- 60	- 40	All Beyond 2 Weeks	400	100-350	50-160	150	Continuous
	600	- 65	- 40		350			162 to 185	
	300	- 98	- 40		110-150			—	
	450	- 30	9		300			—	

characteristics shown are peculiar to a certain compound or class of compounds. Where no material identification has been made, it can be assumed that the characteristics discussed are common to silicone rubber insulating compounds. Many wire and cable fabricators have developed compounds, using General Electric Sili-

cone Rubber gums, in which they have obtained an optimum level of certain characteristics. In many instances it is possible for a wire and cable manufacturer to duplicate General Electric silicone rubber insulating compounds by the use of General Electric silicone rubber gums and our recommended formulations.

RESISTANCE TO TEMPERATURE EXTREMES

Heat resistance usually involves the change in physical properties which may result from exposing insulating materials to anticipated service operating temperatures over an extended period of time, or to short-time emergency overloads which cause a temperature rise well above normal operating temperatures. The following table may be used as a general guide for rating serviceability of standard silicone elastomers on a time-temperature basis.

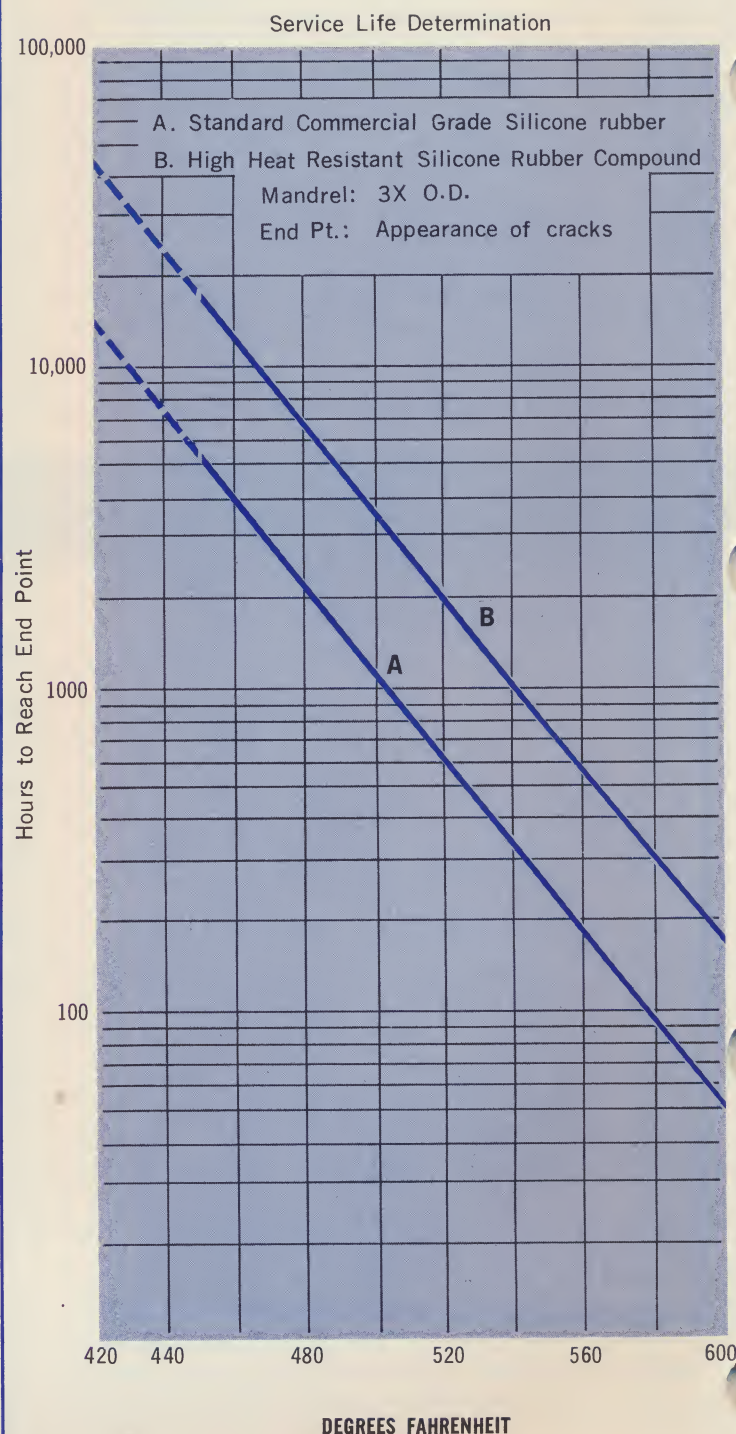
It is important to recognize that the information shown in the following table applies only to a standard, heat-resistant silicone rubber compound designed for use in commercial power cable and formulated to meet proposed IPCEA standards. Silicone rubber compounds having much greater resistance to high temperatures are available and are presently being used in applications of an extremely severe nature. There are also applications in which service conditions are quite moderate and where the use of less heat-resistant compounds is permissible.

**ESTIMATED USEFUL LIFE OF
SILICONE RUBBER**

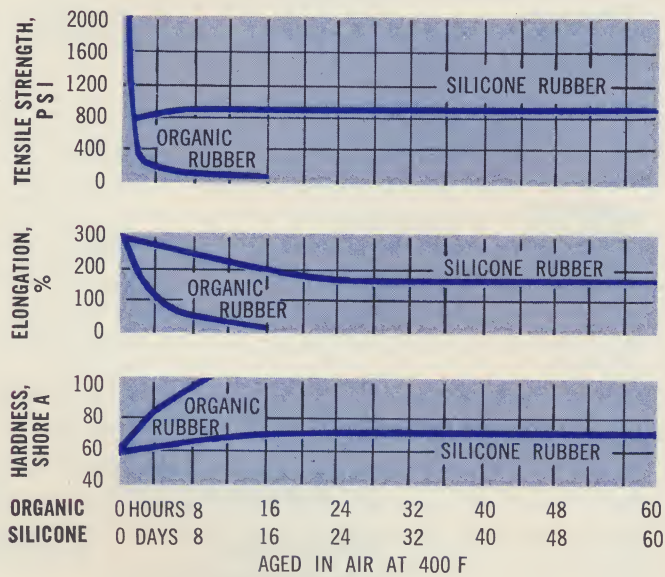
Service Temp.	Useful Life
250F	10 years
300F	5 years
400F	2 years
500F	3 months

The foregoing estimate of useful life is based upon **CONTINUOUS** operation at a conductor temperature as shown. The end-point in the determination of useful life has been arbitrarily selected as that point in time at which the elongation of the insulation has been reduced to a value so low that the material is no longer able to withstand severe and repeated flexing about a small radius. If the cable is not subjected to continuous operation at high temperature, or if the application does not involve severe flexing, the useful life will be significantly extended. For example, in non-flexing service, useful life at 250F is more than 20 years.

The following **ARRHENIUS** plots will serve as an indication of anticipated service life for the various heat-resistant grades of silicone rubber insulation.

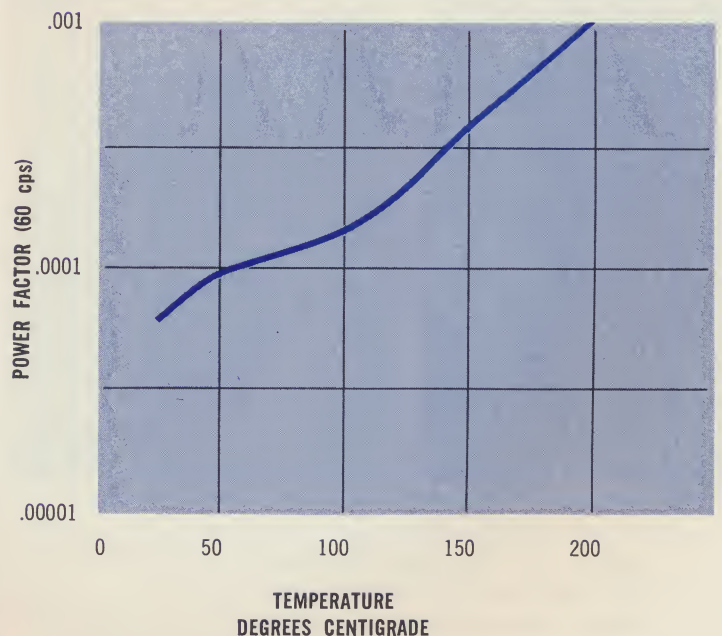
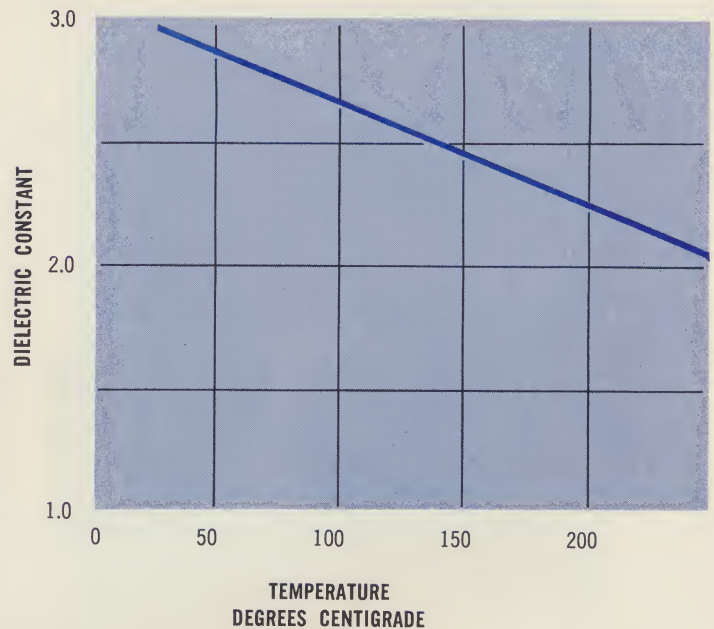


The following graphs illustrate the comparative change in physical properties resulting from short-time exposure of silicone rubber and several organic elastomers to various temperatures.



Note that the time scale for the organic rubber is hours, while that for the silicone rubber is days. Before aging the organic rubber had superior tensile strength and elongation, but after only about an hour at 400F, the organic rubber had deteriorated so badly that it fell below the silicone, and then became progressively worse. The tensile strength of the silicone rubber remained unchanged for many days and the elongation was maintained at a usable value. 400F is by no means the upper limit of usefulness of silicone rubber. Many applications demonstrate the successful use of silicone rubber for long periods at 500F.

Variation of the *electrical characteristics* of silicone rubber at elevated temperatures is indicated by the following data on General Electric SE-9035 silicone rubber insulation compound.

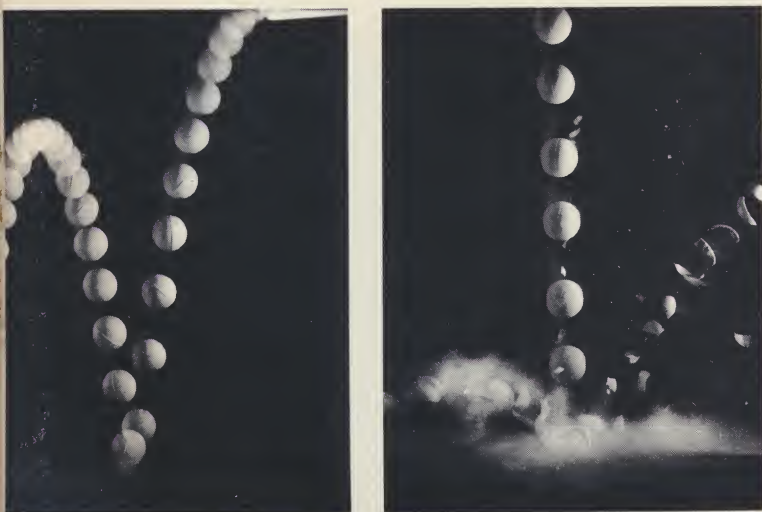
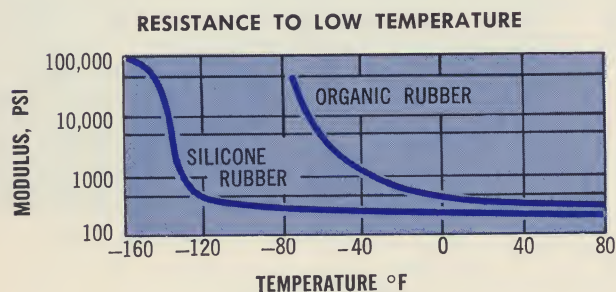


RESISTANCE TO TEMPERATURE EXTREMES (Cont'd.)

The resistance of silicone rubber compounds to extremely low temperatures is exemplified in the following graph. It is evident that the brittle point of the compound tested* is below -150°F . However, of paramount importance is the fact that the flexibility of the rubber is essentially unchanged over the temperature range from $+100^{\circ}\text{F}$. to -80°F . No problems will be encountered in handling stiff wire or attempting to train it into place during the cold-weather months when silicone rubber is used.

Notice the comparison between a typical "low temperature" organic rubber and a typical silicone rubber stock shown in the following graph.

* General Electric SE-9015.

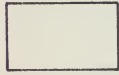


Even at -100°F the silicone rubber ball (left) retains excellent elastomeric properties. The other ball, made from a synthetic elastomer, breaks when dropped.

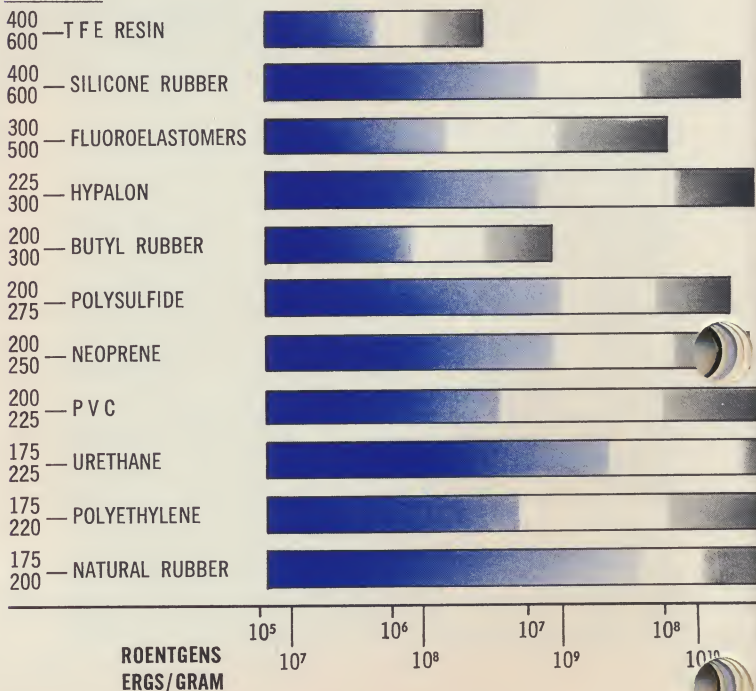
RADIATION RESISTANCE

Silicone rubber is the only flexible insulating material combining excellent heat resistance with a high level of radiation resistance. In severe flexing applications, silicone rubber insulated wire can withstand exposure to 1.0×10^8 Roentgens and still retain useful properties. A comparison of silicone rubber with other insulating materials is shown in the following chart.

RADIATION RESISTANCE OF POLYMERS

INDUCED DAMAGE		UTILITY OF MATERIAL
	INCIPIENT TO MILD	NEARLY ALWAYS USEABLE
	MILD TO MODERATE	OFTEN SATISFACTORY
	MODERATE TO SEVERE	LIMITED USE

TOP TEMP. RATING °F



ROENTGENS
ERGS/GRAM

GAMMA RAY EXPOSURE

FLAME RESISTANCE

Self-extinguishing silicone rubber compounds are available which provide flame-resistant insulation for those applications where this characteristic is desirable. These compounds are capable of passing the Underwriters' Laboratories vertical flame test and the flame test of specification MIL-W-16878 even when applied to the smallest size conductors and without the necessity for flame-resistant outer protective coverings, braids, or lacquers.

FIRE RESISTANCE

When burned, silicone rubber leaves a non-conductive silicon dioxide ash which is an excellent dielectric and which permits continued operation of the cable for an indefinite period. Cables insulated with organic materials fail within 1-5 minutes exposure whereas silicone insulated cables continue to operate for hours, even when subjected to severe vibration.

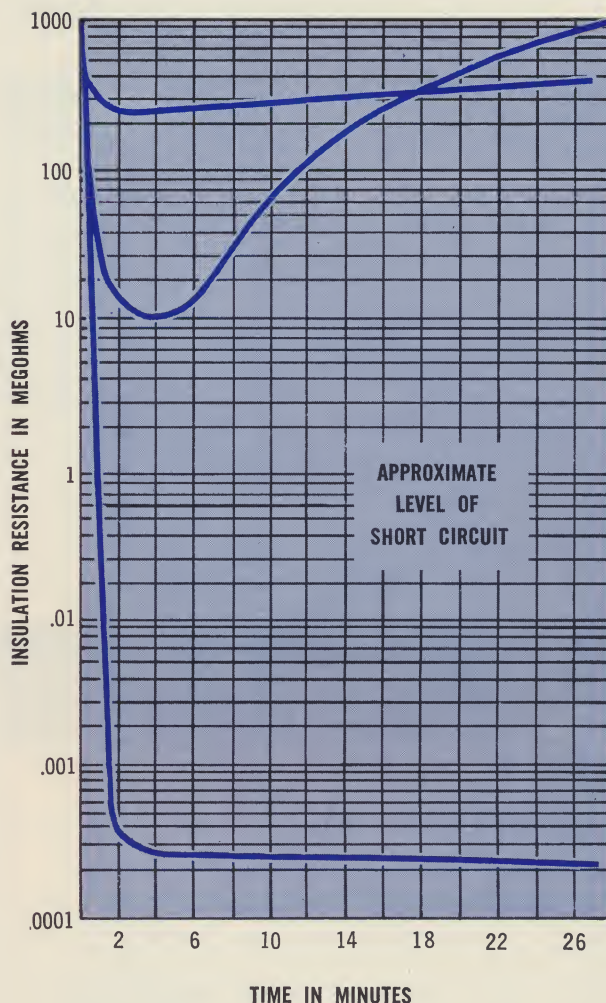
In pre-installation tests on Navy power and control cable, samples are exposed to flame from a 20" ribbon burner. Samples are positioned directly into the flame and voltage is applied between conductors. The sample is expected to maintain electrical integrity for at least 3 hours. The internal temperature approximates 1800°F. during the test, but the silicon dioxide is retained by a glass braid and continues to insulate. Note the performance of silicone rubber insulation as compared with organic insulation when subjected to direct flame at 2000°F.

INSULATION RESISTANCE OF FLEXIBLE SILICONE RUBBER INSULATED WIRE UNDER DIRECT FLAME, MEASURED IN FROM — 0-24 MINUTES.*

Curve A — This is a typical curve of insulation resistance of a shielded single #20 AWG conductor, insulated with silicone rubber while subjected to a 2000° flame. The low point on this plot is of sufficient insulation resistance to maintain circuit integrity.

Curve B — This is a typical curve of insulation resistance of a twisted pair of #20 AWG conductors insulated with silicone rubber made to MIL-W-8777A and subjected to a 2000°F flame.

TYPICAL CURVES OF INSULATION BEHAVIOR
UNDER DIRECT FLAME



Curve C — This is a typical curve of insulation resistance of a twisted pair of #20 AWG conductors insulated with most other common types of insulation material. Under these same test conditions of 2000°F flame, a short circuit would occur after about one minute.

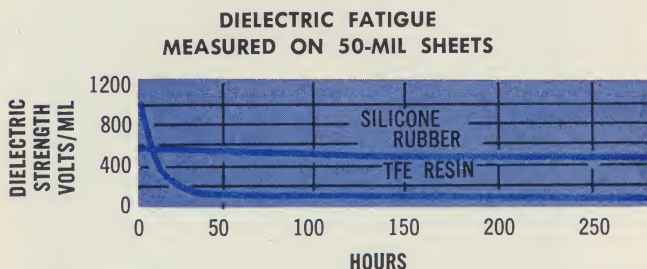
* All tests were performed on a two foot length of wire. Flame was applied on a three inch section with a propane torch. This comparative data is of value to show typical results under the test conditions, and in applications where wire or cable may be subjected to flame for a period of time. It shows that under these conditions silicone rubber insulated wire would maintain circuit integrity during the emergency or flame conditions. Naturally, the silicone rubber insulated wire would be replaced after such exposure.

ELECTRICAL PROPERTIES

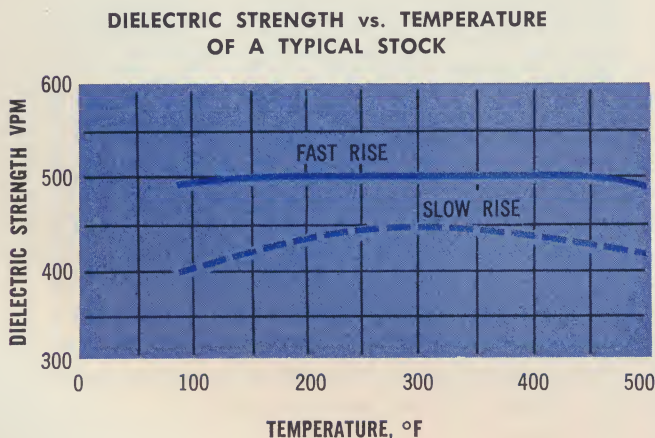
The electrical properties of silicone compare favorably with or exceed the best organic insulation materials. The outstanding advantage of silicone is that it retains excellent characteristics over a wide temperature and frequency range.

DIELECTRIC FATIGUE

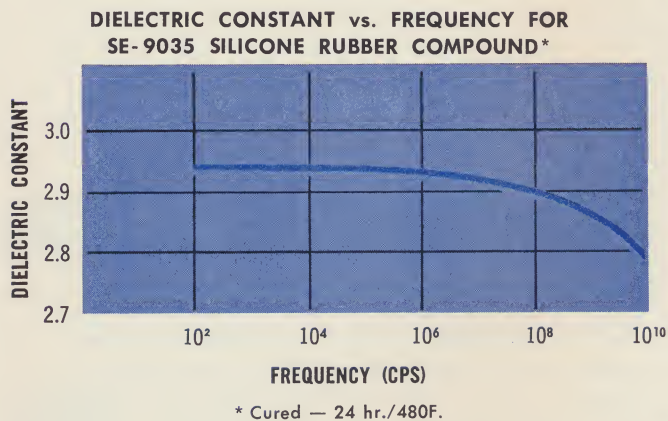
The extreme resistance of silicone rubber insulated wire and cable to high voltage ionization permits operation of silicone rubber insulated wire and cable at high voltage and temperature levels without failure. Corona resistance approaches that of mica with the added advantage of flexibility. Fatigue life under continuous stress is high. High temperature organic polymers exhibit a far more rapid decrease in this characteristic when subjected to voltage for a prolonged period of time. The graph illustrates the comparative resistance of silicone rubber and of TFE resin to dielectric fatigue.



DIELECTRIC STRENGTH for a typical silicone rubber insulation is shown below over the temperature range 80°F to 500°F. It will be noted that the volts/mil electric strength remains essentially constant throughout the temperature range under both fast rise (1000 volts/second) and slow rise (2000 volts/minute).

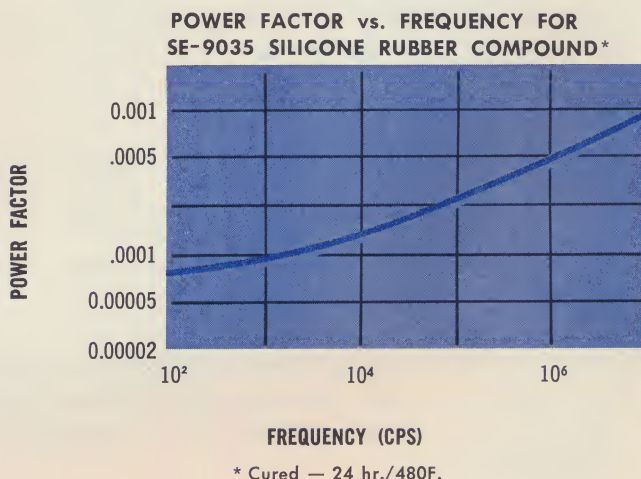


The **DIELECTRIC CONSTANT** of present compounds ranges between 2.9 and 3.5 depending upon the type of filler used. This value remains relatively constant throughout a wide frequency range. A slight decrease in dielectric constant is noted at very high frequencies (see graph below). Silicone rubber insulated co-axial cable is being used in support cable for the Polaris missile at frequencies up to 30 megacycles.



The **POWER FACTOR** of silicone rubber insulation, at commercial frequency, varies between .00008 and .006 depending upon the filler system. With SE-9035 compound a low value is maintained over a wide frequency range (see graph below). At VHF and UHF frequency the power factor becomes progressively higher and losses increase.

When the power factor is plotted vs frequency, it is noted that silicone rubber insulation (SE-9035) is suitable for use in high-frequency circuits. In these applications silicone rubber offers the added advantage of moisture resistance, flexibility and heat-resistance at a relatively low cost.



CORONA AND OZONE RESISTANCE

Ozone and corona resistance should be distinguished as they affect insulating materials. Corona, the ionization of gas which leads to a discharge current of ionized particles, can easily damage and deteriorate electrical insulation. Continued corona discharge eventually causes electrical failure.

The fact that corona discharge in air is known to generate ozone, and that corona attack of elastomers produces surface cracking, does not necessarily mean that ozone attack is the only factor involved.

Evidence indicates that corona damage can occur in the absence of oxygen. Fluoro-carbon materials, such as TFE resins, have good ozone resistance but degrade rapidly when subjected to corona. Silicone rubber is outstanding in its resistance to both ozone and corona conditions.

To determine the resistance of silicone rubber insulated wire to high voltage gradients, samples of #20 AWG wire with 3/64 inch wall of insulation have been subjected to a 10,000 volt potential while wrapped in helical form (outer surface elongated 25%) and placed in an oven at 250°C. for 100 hours. There were no signs of stress cracking or corona erosion at the conclusion of this test. Under these conditions organic rubber insulations failed within a few minutes even when the test was conducted at room temperature.

FUNGUS RESISTANCE

Properly cured silicone rubber will not support the growth of fungus. Samples of silicone rubber have been successfully tested against the two major military specifications for fungus resistance: MIL-F-8261, Fungus, Resistance Tests, Aeronautical and Associated Materials, General Specification For; and MIL-E-5272A, Environmental Testing, Aeronautical and Associated Equipment, General Specification For. The fungi included in these tests were: *Aspergillus Niger*, *Aspergillus Flavus*, *Trichoderma T-1*, *Chaetomium Globosum*, *Penicillium Luteum*, *Memnoniella Echinata*.

CHEMICAL RESISTANCE

Silicone rubber's resistance to chemicals is particularly useful at temperatures which prevent the use of other elastomers. The following table shows the effect of a variety of materials on a general purpose, silicone rubber compound after one week's immersion at 77F.

Material	Weight Change %	Volume Change %	Durometer Change Points
ACIDS			
Nitric conc.	+10	+10	-30
Nitric 7%	<1	<1	-2
Sulfuric conc.		Disintegrates	
Sulfuric 10%	<1	<1	-2
Acetic conc.	+2	+3	-4
Acetic 5%	+4	+4	-8
Hydrochloric conc.	+1	+1	-6
Hydrochloric 10%	+2	+4	-4
Hydrochloric 3%	<1	+1	-2
BASES			
Sodium Hydroxide 20%	<1	<1	-2
Sodium Hydroxide 1%	<1	<1	-4
Ammonium Hydroxide conc.	+2	+2	-4
Ammonium Hydroxide 10%	+3	+2	-6
SALTS			
Sodium Chloride 10%	<1	<1	-2
Sodium Carbonate 2%	<1	<1	0
SOLVENTS			
Ethyl Alcohol	+5	+6	-10
Acetone	+5	+15	-15
Toluene	+75	+120	-30
Gasoline, Regular	+65	+130	-25
Gasoline, Aviation	+60	+110	-30
Mineral Spirits	+65	+110	-30
Carbon Tetrachloride	+130	+110	-25
HYDRAULIC FLUIDS			
Hollingshead H-2	+4	+5	-10
Hollingshead H-2 ¹	+9	+12	-15
Skydrol	+4	+4	-8
Skydrol ¹	+7	+8	-10
PRL3161	+5	+7	-8
PRL3161 ¹	+9	+9	-15
OILS			
Castor Oil	<1	<1	-4
Lard Oil	<1	<1	-4
Linseed Oil	<1	<1	-2
Mineral Oil	+5	+6	-6
ASTM #1 Oil ²	+3	+5	-6
ASTM #3 Oil ²	+20	+31	-20
Silicone Oil SF96 (100) ²	+25	+35	-25
Silicone Oil 42,000 cstk. ²	+9	+10	-12
OTHER			
Water	<1	<1	<1
Hydrogen Peroxide 3%	<1	<1	<1
Pyranol 1476	+4	+4	-8

¹ 70 hours @ 212F.

² 70 hours @ 300F.

RESISTANCE TO WEATHERING

Silicone rubber resists the deteriorating effects of sunlight, ozone, and gases which cause weathering. Inherently water repellent, silicone rubber is not affected by moist operating

RESISTANCE TO WEATHERING (Cont'd.)

conditions. Very dry conditions and low humidity will not leach, dry out, or affect silicone rubber in any way, at any temperature extreme found in nature.

Silicone rubber also has good resistance to deteriorating agents found in rain water: chloride, sulfate, nitrate, and hydrogen ions. Surface water which may have leached minerals, acids, bases, and salts from the soil normally has no detrimental effect on silicone rubber. Silicone rubber will effectively resist the concentrations of such materials found in surface water.

**SILICONE RUBBER RESISTANCE
TO CHEMICALS COMMONLY FOUND IN SOIL**

Chemical	Resistance
ACIDS:	
Hydrochloric 3%	Good
Phosphoric 10%	Good
Sulphuric 10%	Good
BASES:	
Sodium Hydroxide 1%	Good
Potassium Hydroxide 1%	Good
SALTS:	
Calcium Carbonate	Good
Calcium Chloride	Good
Calcium Hydroxide	Good
Sodium Carbonate 2%	Good
Sodium Chloride 10%	Good

INERTNESS

An inert material, silicone rubber is odorless and tasteless. Because it is extremely stable and contains no sulphur or other acid producing chemicals, it does not cause staining, corrosion, or deterioration of other materials with which it comes in contact.

VACUUM PERFORMANCE

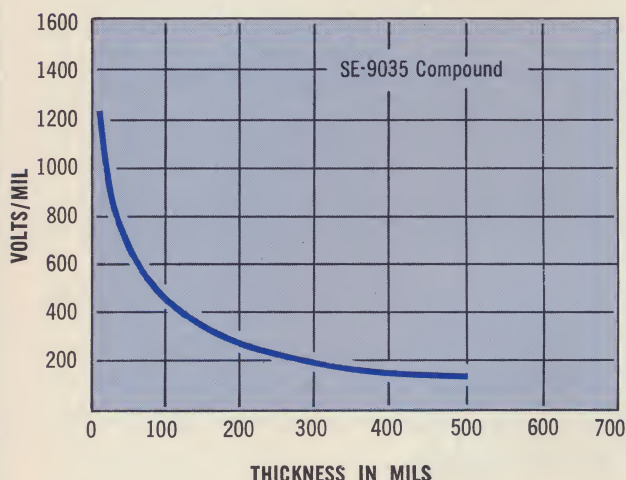
Silicone rubber is completely unaffected by the low pressure conditions encountered in high altitude aircraft. In vacuums of 10^{-4} millimeters of mercury, there is an extremely small loss of low molecular weight material as indicated in the table below:

**PERCENT WEIGHT LOSS OF SILICONE
RUBBER AT 10^{-5} mm Hg**

Temperature	Time (Hours)		
	24	89	168
77F	0.03	0.09	0.11
210F	0.54	0.83	1.00
400F	1.72	1.73	1.80

SILICONE RUBBER INSULATION FOR HIGH-VOLTAGE AND HIGH-FREQUENCY CABLE

A review of the electrical characteristics of a newly developed insulation compound (SE-9035) indicates it to be eminently suitable for use as a high-voltage cable. Measurement of dielectric strength vs insulation thickness shows equivalence with polytetrafluoroethene and polyethylene with the added advantages of resistance to dielectric fatigue and to high ambient temperatures.



As noted in previous graphs, the power factor at commercial frequencies is approximately 0.00008 and the dielectric constant is 2.96. At rated operating temperature of 125 C it is 0.0003 for SE-9035.

DATA AND CONSTRUCTION DETAILS FOR SILICONE RUBBER INSULATED WIRE AND CABLE

The following details of construction are intended to furnish information on available typical silicone rubber insulated wire and cable. Certain minor details of construction will vary between manufacturers, but insulation thickness has been standardized in accordance with industry requirements for various voltage levels and current carrying capacity has been calculated in accordance with recognized IPCEA methods. Wherever the intended application of a silicone rubber insulated wire or cable may be unique or unusually severe it is strongly recommended that advice be sought from a wire manufacturer and/or from the General Electric Silicone Products Department in Waterford, New York.

A complete description of the intended application and of the anticipated operating conditions will permit the design of a cable and an insulation compound to meet the specific needs of the intended service. Many of the items shown on the following pages are available immediately from manufacturers' stock. Other items will necessarily be made to order. We have not attempted to include recommended insulating compounds on the following pages since such information tends to become rapidly obsolete and since many suppliers of silicone rubber insulated wire and cable have developed their own formulations which they mix from General Electric silicone rubber gums. Current recommendations for specific applications can be obtained from the General Electric Silicone Products Department in Waterford, New York.

COMMERCIAL WIRE & CABLE

SINGLE CONDUCTOR POWER CABLE* 600 VOLTS

125°C maximum conductor temperature

APPLICATION: Power circuits in wet or dry locations exposed or in conduit . . . to withstand high temperatures.

*Also available with multiconductors in several cable types

Conductor		Insulation Thickness in 64ths	Nominal ⁽¹⁾ Over-all Diam. in Inches	Nominal ⁽²⁾ Conduit Size in Inches	Approx. Net Wt. in Lb. per M Ft.
Size Awg. or MCM	No. of Strands				
14	7	3	.26	3/4	36
12	7	3	.28	3/4	46
10	7	3	.30	3/4	62
8	7	4	.37	1	100
6	7	4	.40	1 1/4	135
4	7	4	.45	1 1/4	190
2	7	4	.51	1 1/4	280
1	19	5	.58	1 1/2	355
0	19	5	.63	2	440
00	19	5	.67	2	530
000	19	5	.72	2	650
0000	19	5	.78	2	810
250	37	6	.86	2 1/2	1000
350	37	6	.97	3	1300
500	37	6	1.10	3	1800

(1) Slight differences in over-all diameter will occur among the various manufacturers.
(2) Based upon 3 insulated cables in a conduit (NEC).

CURRENT CARRYING CAPACITY

(Continuous Current Load in Amperes at 40°C Ambient Temperature* and 125°C maximum Conductor Temperature)

Conductor Size (Awg. or MCM)	Single Conductor in Air	Single Conductor Cables in Conduit Enclosed or Exposed			Three-Conductor Cable in Air
		1 Cable/Conduit	2 Cables/Conduit	3 Cables/Conduit	
14	37	35	30	27	
12	50	45	38	35	
10	62	62	53	48	
8	87	80	68	62	75
6	117	105	93	82	93
4	160	136	124	110	124
2	218	186	162	146	160
1	250	210	185	166	185
0	290	240	210	192	210
00	340	280	248	219	250
000	400	320	280	252	280
0000	460	370	320	293	320
250	510	415	360	324	355
350	645	510	440	395	440
500	795	625	545	484	545

* For Ambient Temperatures other than 40°C multiply the current rating shown in the table by the correction factor listed below.

Correction Factors For Various Ambient Air Temperatures

10C	1.16
15C	1.14
20C	1.11
25C	1.08
30C	1.06
35C	1.03
40C	1.00
45C	0.97
50C	.94
55C	.91
60C	.88
65C	.84
70C	.81
75C	.77

AC Voltage Drop per Foot at Rated Current and 80% PF

Wire Size (Awg. or CM)	Conduit	Air
8	.056	.061
6	.047	.053
4	.040	.045
2	.034	.037
1	.030	.033
0	.029	.032
00	.026	.030
000	.0242	.0274
0000	.0238	.0260
250	.0225	.0248
350	.0222	.0245
500	.0218	.0244

**Asbestos braid for use in conduit. Also available in colors and in combinations with colored singles and a protective over-all covering.

SINGLE CONDUCTOR POWER CABLE* 5000 VOLTS

125 C maximum conductor temperature

APPLICATION: Power circuits in wet or dry locations exposed or in conduit . . . to withstand high temperatures.

*Also available with multiconductors in several cable types

Conductor		Insulation Thickness in 64ths	Nominal Over-all Diam. in Inches	Nominal Conduit Size in Inches	Approx. Net Wt. in Lb. Per M Ft.
Size Awg. or MCM	No. of Strands				
8	19	10	.56	1½	175
6	19	10	.60	1½	225
4	19	10	.65	2	285
2	19	10	.71	2	390
1	19	10	.75	2	460
0	19	10	.79	2½	535
00	19	10	.84	2½	650
000	19	10	.89	2½	780
0000	19	10	.95	3	940
250	37	11	1.02	3	1100
350	37	11	1.13	3	1450
500	37	11	1.26	3½	2000

Three insulated conductors per conduit (NEC).

CURRENT CARRYING CAPACITY

(Continuous Current Load in Amperes at 40C Ambient Temperature* and 125C maximum Conductor Temperature)

Conductor Size (Awg. or MCM)	Single Conductor in Air	Single Conductor Cables in Conduit Enclosed or Exposed			Three-Conductor Cable in Air
		1 Cable/Conduit	2 Cables/Conduit	3 Cables/Conduit	
8	87	80	68	62	75
6	117	105	93	82	93
4	160	136	124	110	124
2	218	186	162	146	160
1	250	210	185	166	185
0	290	240	210	192	210
00	340	280	248	219	250
000	400	320	280	252	280
0000	460	370	320	293	320
250	510	415	360	324	355
350	645	510	440	395	440
500	795	625	545	484	545

* For Ambient Temperatures other than 40C multiply the current rating shown in the table by the correction factor listed below.

Correction Factors For Various Ambient Air Temperatures

10C	1.16
15C	1.14
20C	1.11
25C	1.08
30C	1.06
35C	1.03
40C	1.00
45C	0.97
50C	.94
55C	.91
60C	.88
65C	.84
70C	.81
75C	.77

**Asbestos braid for use in conduit. Also available in colors and in combinations with colored singles and a protective over-all covering.

COMMERCIAL WIRE & CABLE

BRAID Asbestos**

INSULATION Silicone rubber

CONDUCTOR Coated copper



COMMERCIAL WIRE & CABLE

SINGLE CONDUCTOR POWER CABLE **15000 VOLTS** (grounded or ungrounded)

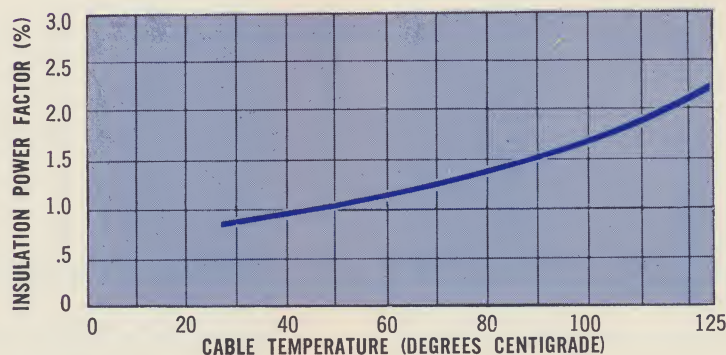
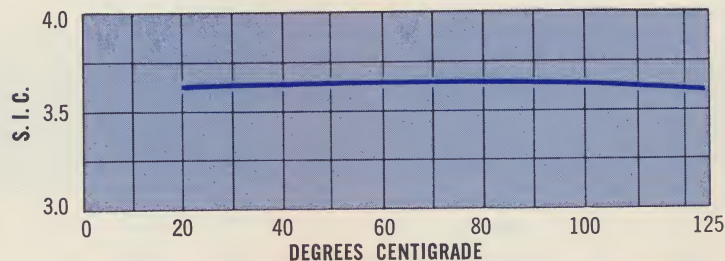
125 C maximum conductor temperature

APPLICATION: For high-current generator lead applications or where space is not available for conventional cable or bus, silicone rubber generator leads are available for generator voltages now being supplied. By means of acceptable methods of ventilation and proper arrangement of cables, silicone rubber insulated generator leads are capable of carrying loads up to and including 400 mva.

Size MCM	Cond. Diam. in Inches	GROUNDED NEUTRAL		UNGROUND NEUTRAL	
		Insulation Thickness in Inches	O.D. in Inches	Insulation Thickness in Inches	O.D. in Inches
1000	1.155	.200	1.683	.260	1.803
1250	1.267	.200	1.795	.260	1.915
1500	1.410	.200	1.938	.260	2.058
1750	1.505	.200	2.033	.260	2.153
2000	1.610	.200	2.138	.260	2.258
2250	1.692	.200	2.220	.260	2.340
2500	1.800	.200	2.328	.260	2.448
3000	1.950	.200	2.478	.260	2.598

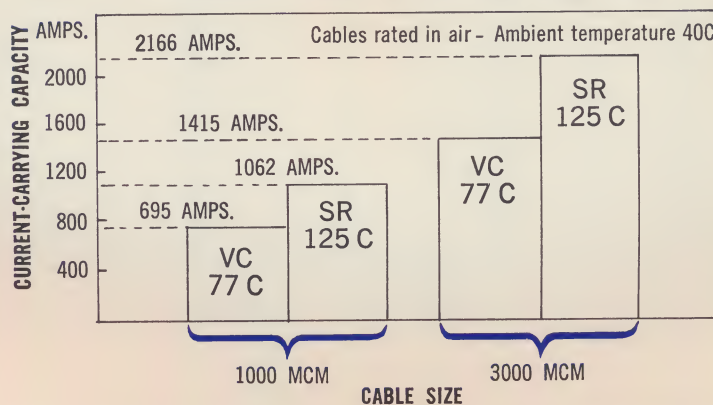
DIELECTRIC PROPERTIES OF SILICONE RUBBER GENERATOR CABLE

Typical test results obtained on single-conductor, 2500 MCM, 15 kv cable, insulated with 0.25 inches of silicone rubber-coated glass tapes.



COMPARISON OF CURRENT-CARRYING RATINGS

Varnished Cambric vs. Silicone Rubber Glass



MULTI-CONDUCTOR CONTROL CABLE 600 VOLTS

APPLICATION: Recommended for connection of control or signal circuits, in wet or dry locations, to withstand constant high temperatures.

Metallic Armor

No. of Cond.	Approx. O.D. in Inches	Current-Carrying Capacity 40C Ambient (Amperes)	Approx. Net Wt. in lb.* per M Ft.
--------------	------------------------	---	--------------------------------------

No. 12 Awg. (7 strands)

2	.62	38	290
3	.64	35	360
4	.71	(1)	435
5	.77	(1)	515
6	.84	(1)	620
7	.84	(1)	655
8	.97	(1)	785
9	1.04	(1)	895
10	1.05	(1)	920
12	1.09	(1)	1040

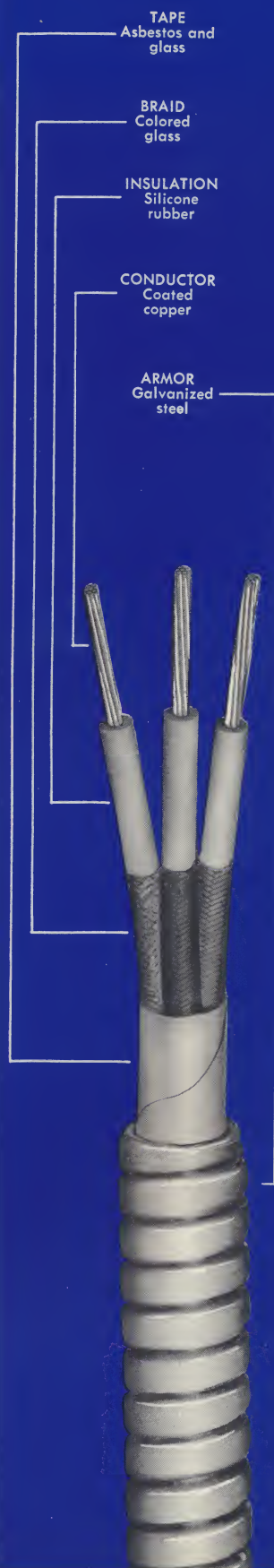
No. 10 Awg. (7 strands)

2	.67	53	324
3	.70	48	400
4	.77	(1)	490
5	.84	(1)	605
6	.91	(1)	710
7	.91	(1)	775
8	1.06	(1)	885
9	1.14	(1)	1005
10	1.15	(1)	1050
12	1.19	(1)	1180

* Also available with aluminum armor, silicone rubber jacket or asbestos braid.

(1) Calculations should be made for specific systems to take into consideration load factor, number of circuits operating concurrently, etc.

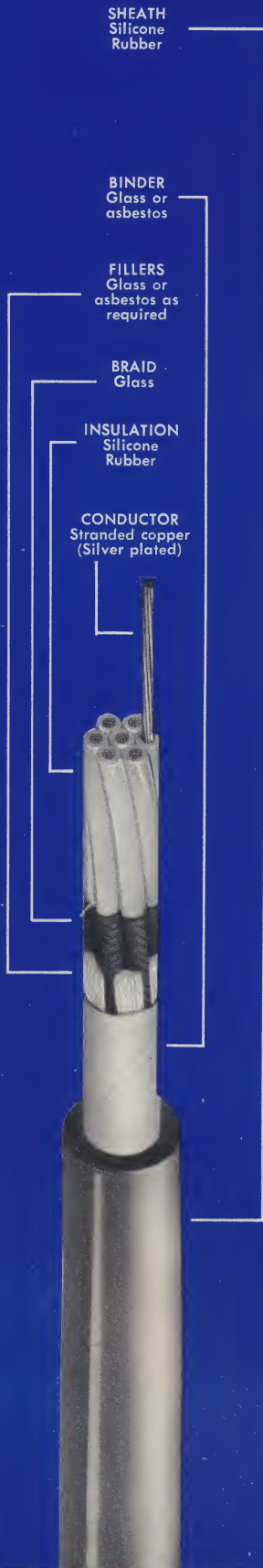
COMMERCIAL WIRE & CABLE



COMMERCIAL WIRE & CABLE

MULTI-CONDUCTOR CONTROL CABLE-SILICONE RUBBER JACKET 600 VOLT SERVICE*

APPLICATION: Multi-conductor control cables are recommended for use in signal or control circuits in either wet or dry locations where exposed to high temperatures.



Number of Conductors	Conductor Size (AWG)	Stranding	Insulation Thickness (Inches)	Shield	Braid	Jacket Thickness (Inches)	Over-all Diameter (Inches)
2	12	19/25	0.023	—	—	0.060	0.410 ±010
3	12	19/25	0.023	S.P.	—	0.060	0.425 ±010
2	14	19/27	0.027	—	—	0.031	0.315 ±005
4	14	19/27	0.023	—	Glass	0.062	0.455 ±010
2	16	19/29	0.015	—	Glass	0.030	0.250 ±010
4	16	19/29	0.015	—	—	0.040	0.335 ±010
6	16	19/29	0.015	—	—	0.030	0.335 ±010
8	16	19/29	0.015	—	—	0.060	0.490 ±010
12	16	19/29	0.015	S.P.	—	0.060	0.500 ±010
16	16	19/29	0.015	—	Glass	0.050	0.530 ±015
32	16	19/29	0.015	—	—	0.085	0.860 ±025
3	20	19/32	0.015	—	—	0.040	0.230 ±010
4	20	19/32	0.015	—	—	0.050	0.275 ±010
6	20	19/32	0.015	S.P.	—	0.020	0.300 ±010
10	20	19/32	0.015	—	—	0.060	0.450 ±010
14	20	19/32	0.015	—	—	0.060	0.490 ±010
18	20	19/32	0.015	—	—	0.060	0.530 ±010
28	20	19/32	0.015	—	—	0.070	0.610 ±010
32	20	19/32	0.015	—	—	0.032	0.620 ±010

* These cables find wide service in missile and aerospace applications. The use of a silicone rubber jacket and inorganic fillers permits operation at temperatures up to 480F.

SINGLE CONDUCTOR MOTOR AND APPARATUS LEADS 600 VOLTS

200 C maximum conductor temperature

APPLICATION: For high temperature applications where flexibility is required, such as leads for motors, transformers, etc. Maximum conductor temperature is 200C (392F).

Size Awg.	Conductor Stranding	Insulation Wall Thickness 64ths-Inch	Approx. O.D. (Inches)	Approx. Net Wt. in Lb. per M Feet
8	37/24	4	.36	92
6	61/24	4	.40	131
4	105/24	4	.49	203
2	150/24	4	.55	273
1	225/24	5	.64	395
0	275/24	5	.70	480
00	375/24	5	.73	615
000	450/24	5	.77	725
0000	550/24	5	.87	880

CONDUCTOR
Extra flexible
stranding

INSULATION
Silicone
rubber

BRAID
Asbestos
silicone
varnish treated

SINGLE CONDUCTOR APPARATUS LEADS 600 VOLTS

200 C maximum conductor temperature

APPLICATION: Apparatus leads are recommended for Class B, Class F, and Class H service where a flexible, moisture-resistant, high-temperature resistant lead wire is required.

Conductor Size (AWG)	Number and Size of Strands (Inches)	Insulation Thickness 64ths-Inch	Nominal Over-all Diameter (Inches)	Approx. Net Wt. in Lb. per M Feet
18	16 x .010	2	.123	10
16	26 x .010	2	.136	14
14	41 x .010	3	.182	25
12	65 x .010	3	.200	34
10	104 x .010	3	.224	49
8	133 x .011	4	.307	82
6	133 x .014	4	.350	114
4	133 x .0177	4	.406	171
2	133 x .0223	4	.475	243
1	259 x .0180	5	.549	334
1/0	259 x .0202	5	.595	411
2/0	259 x .0227	5	.648	505
3/0	259 x .0255	5	.707	625
4/0	259 x .0236	5	.772	772

CONDUCTOR
Stranded
copper

INSULATION
Silicone
rubber

BRAID
Glass

COMMERCIAL WIRE & CABLE

APPLIANCE AND FIXTURE WIRE 600 VOLTS

200 C maximum conductor temperature

APPLICATION: For wiring all types of interior lighting fixtures and other high-wattage units, such as sunlamps, therapeutic devices, internal wiring for clothes dryers, air conditioners, oil burners.

Listed by Underwriters' Laboratories, Inc.



Size Awg.	Conductor Stranding	Insulation Thickness in 64ths	Approx. O.D. in Inches	Ship. Wt. in Lb. per M Ft.
18	7/.0153	2	.128	15
16	7/.0192	2	.142	19
14	7/.0242	2	.163	26
12	19/.0185	2	.183	38
10	19/.0234	3	.230	62

APPLIANCE AND FIXTURE WIRE 600 VOLTS

150 C maximum conductor temperature

APPLICATION: For wiring all types of interior lighting fixtures and other high-wattage units, such as sunlamps, therapeutic devices, etc., especially where the maximum temperatures are 150 C. Maximum temperature is dictated by finer stranding.

Listed by Underwriters' Laboratories, Inc.



Size Awg.	Voltage	Conductor Stranding	Insulation Thickness in 64ths	Approx. O.D. in Inches	Ship. Wt. Lb. per M Ft.
22	300	7/.010	1	.075	6
22	600	7/.010	2	.105	10
20	300	10/.010	1	.090	8
20	600	10/.010	2	.120	11
18	300	16/.010	1	.100	11
18	600	16/.010	2	.128	15
16	600	26/.010	2	.142	19
14	600	41/.010	2	.163	26
12	600	65/.010	2	.183	38
10	600	65/.0126	3	.240	62

HEATING CABLE

APPLICATION: May be used in pipe heating, roof de-icing, soil heating, etc. The excellent heat and moisture resistance of silicone rubber permits a variety of applications.

The tinned copper braid provides a built-in means of grounding, eliminating the necessity of installing in a metal enclosure, such as conduit.

The relative flexibility of the cable improves the efficiency of heat transfer because it can be made to hug surfaces more tightly than lead jacketed constructions.

Rating*— 10 watts per foot.

Conductor**— Approx. 0.53 ohms per linear foot.

NO. 19 AWG

50 ft on 115 V— consumes 500 watts

100 ft on 230 V— consumes 1000 watts

200 ft on 460 V— consumes 2000 watts

CAUTION: USE PROPER LENGTHS

Silicone rubber heating cable has been made possible by the development of silicone rubber which is an excellent heat- and moisture-resistant cable insulation. This cable has several advantages over the lead-jacketed type:

1. Because of its better heat resistance it can be rated higher — 10 watts per foot compared to 6.7 watts per foot.
2. Because no lead sheath is used, vulnerability to chemical attack on the sheath such as can occur from lime in cement or industrial contaminants in other applications is practically eliminated.
3. Because it is much less bulky, it can be made to hug surfaces more tightly than lead-jacketed cable.

Because silicone rubber insulated heating cable is impervious to the moisture and the lime in concrete, it can be used embedded in sidewalks, driveways, etc., without further protection.

The high rating of 10 watts per foot also lends economy to the installation in many cases. Where less than 10 watts per foot is needed, longer lengths may be used.

HEATING CABLE AS A COMPONENT

Heating cable is often used by machinery and equipment manufacturers as a component in their products to provide local heat. Typical examples of this are heating units in textile machines and refrigerated showcases. Special nonleaded silicone rubber heating cables are used for heating units for domestic refrigerators. Where standard heating cable is not practical, special design cables can often be constructed to meet special requirements.

PIPE HEATING APPLICATION

Pipe heating in industrial and commercial applications is one of the widest present uses of bulk heating cable.

In such applications, silicone rubber cable may be spiralled around the pipe or one or more cables may be strapped parallel to the pipe. Because spiralling the cable around a pipe often requires a considerable amount of labor, most users, except on very small jobs, prefer to strap the cable longitudinally to the pipe.

*Special constructions may be designed for lower or higher rating.

**Conductor resistance may be altered to make provision for the use of circuit lengths other than those shown in the table.

COMMERCIAL WIRE & CABLE

CONDUCTOR
Solid
nickel-chromium
alloy

WRAP
Glass yarns

INSULATION
Silicone
rubber

SHIELD
Tinned copper
braid

HEATER WIRE

CONDUCTOR

May be stranded conductor of high resistance alloy or resistance wire wrapped helically around a glass or asbestos fiber core. Range of conductor resistance available up to 30,000 ohms/foot.

INSULATION

High temperature resistant, moisture-resistant, non-toxic silicone rubber compound.

COVERING

Glass braid finished with high-temperature resistant lacquer. Also available with braided shields, jackets, metallic armor, etc. to suit specific application requirements.

APPLICATIONS

Used to defrost and to prevent condensation in industrial and consumer refrigeration systems, as a component of heater blankets for missiles.

Operating temperature 150°C.-200°C.

Voltage — 300 volts



COMMERCIAL IGNITION CABLE

7 MM Silicone Rubber

APPLICATION: Commercial Ignition Cable is used for utmost reliability in internal combustion engines. Where elevated temperatures, moisture, and other severe ambient conditions require the use of a superior insulation material.

Size	Outside Diameter	Weight Lbs. Per M/Ft.
7 MM	.270"-.280"	50

For extremely high temperature wires, silicone insulation of a type similar to that used on the government high tension wire is used to insulate 19 x 29 tinned conductor. A glass braid with a silicone varnish is applied over this insulation to the diameter of .270" x .280". A similar construction using 7 x .013 stainless steel is available. These two wires are designed to work at temperatures of 480°F for long periods of time. This same cable will remain flexible at extremely low temperatures also.

CONSTRUCTION

7 MM-16 gauge conductor 19 strands of No. 29 tinned copper wire insulated with silicone

rubber and heavy glass braid impregnated with heat-resisting silicone varnish.

COMMERCIAL IGNITION CABLE

7 MM Silicone Rubber Insulation with Silicone Rubber Jacket

APPLICATION: Commercial Ignition Cable is used for utmost reliability in internal combustion engines, where elevated temperatures, moisture, and other severe ambient conditions require the use of a superior insulation material.

Size	Outside Diameter	Weight Lbs. Per M/Ft.
7 MM	.270"-.280"	50

Made to latest automotive specifications, this cable is recommended for operating conditions of extreme moisture and for its resistance to heat, oil and corona.

CONSTRUCTION

7 MM-stainless steel conductor* with insula-

tion of silicone rubber reinforced with glass braid and silicone jacket.

* This cable is also available with the distributed resistance core. It does not have a metallic conductor, but rather uses a carbon impregnated fibrous material as the conductor, which cable has been found extremely effective in suppressing the radio interference generated

by the high tension spark. The cable is constructed using a core of conducting fibrous material insulated with silicone rubber and jacketed to the diameter .270"-.280" with silicone rubber.

COMMERCIAL WIRE & CABLE



COMMERCIAL WIRE & CABLE



CONDUCTOR
Stranded,
silver-plated
copper

INSULATION
Silicone
rubber

SINGLE CONDUCTOR HIGH VOLTAGE CABLE

APPLICATION: High Voltage silicone rubber insulated cable is used for both ac and dc circuits to withstand heat, moisture, ozone and corona.

AWG	Stranding	Cable Nominal Diameter	Rating Volts-AC
24	19/36	0.155"	5000
22	19/34	0.130"	5000
20	19/32	0.125"	5000
20	19/32	0.170"	7500
18	19/30	0.140"	7500
18	19/30	0.213"	10000
*18	19/30	0.236"	12500
*18	19/30	0.245"	15000
*18	19/30	0.371"	20000
*16	19/29	0.280"	15000
*16	19/29	0.300"	15000
16	19/29	0.290"	15000
14	19/27	0.390"	20000
*14	19/27	0.300"	15000
12	19/25	0.320"	20000

* All of the above cables are available with shielded and non-shielded semi-conducting layer over the wire conductor.

NOTE: High voltage cables can be designed and built for 100,000 volts service.

COMMERCIAL SPECIFICATIONS

	UNDERWRITERS' LABS CLASS 22					CANADIAN STANDARDS ASSOCIATION TYPE SEW			
	SA	SF-1	SF-2	SFF-1	SFF-2	SEW-1	SEW-2	SEWF-1	SEWF-2
Application	Silicone Rubber Fixture Wire					Silicone Rubber Equipment Wire			
Temperature Rating	125C	200C	200C	150C	150C	200C	200C	(150C Copper: 200C Nickel)	
Voltage Rating	600V	300V	600V	300V	600V	300V	600V	300V	600V
PHYSICAL PROPERTIES									
Original — As Received									
Tensile Strength, psi, Min.	800	500	500	500	500	700	700	700	700
Elongation, %, Min.	250	100	100	100	100	100	100	100	100
High Temperature Aging		Air Oven 60 Days/210C				Air Oven 60 Days/210C			
Tensile Strength	75%	500 psi or 60% of Original				500 psi	500 psi	500 psi	500 psi
Elongation	65%	50% or 25% of Original				50%	50%	50%	50%
ELECTRICAL PROPERTIES									
Original — As Received									
Insulation Flaws									
Insulation Resistance	7.5-15 KV 800-150 meg- 1000 ft.	3 KV	6 KV	3 KV	6 KV				
High Temperature						24 Hr/210C — Tested at 210C			
Dielectric Strength, 1 Min. Hold						1000V	1500V	1000V	1500V
Insulation Resistance						Subject of Special Investigation			
High Temperature Aging						Test 1-60 Days/210C, Test 2-1 Hr/250C			
Dielectric Strength, 1 Min. Hold						1000V	1500V	1000V	1500V
						(60 Days/210C Test Only — Flexibility + D.S.)			
PERFORMANCE PROPERTIES									
Original — As Received						Subject of Special Investigation. No Soft- ening, Tackiness, or Other Adverse Effect			
Cutting Resistance						(96 Hrs/210C — Sealed Conduit)			
Depolymerization Test									
Flammability		Burning Time — 1 Min., Max. No Conveying of Flame				Burning Time — 1 Min., Max. No Conveying of Flame			
Low Temperature Flex						1 Hr/-30C + Wrap + D. S. Test			
						1 Min/ 1000V	1 Min/ 1500V	1 Min/ 1000V	1 Min/ 1500V
HIGH TEMPERATURE AGING		Air Oven 60 Days/210C No Rupture of Braid Nor Insulation when Wrapped 6 Times Around Mandrel.							

The specification requirements are shown for information only and are based on the most recent data available to General Electric Silicone Products Department. No guarantee is made that this data is current or accurate. It is recommended that the actual specification be reviewed.

MOTOR AND APPARATUS LEAD WIRE

Many types of lead cable are used as external connection to motors and other electrical machines. The current carrying capacity of these leads depends on the type of insulation, conductor material, conductor size, and service conditions. No industry standards or specifications are available to provide guidance when designing or specifying this type of lead cable. During the past several decades, advances in insulating materials have led to significant reduction in size and cost of electrical apparatus for a given horsepower or kilowatt output. Until the advent of silicone rubber insulated lead wire, however, little improvement had been made in the heat resistance of the lead cables used with this apparatus. At present, silicone rubber insulated lead cable is used for Class B through Class H applications. In many cases the thermal characteristics of silicone rubber insulated cable are not necessary for Class B and F service. However, an increase in current density to utilize the thermal ratings of this insulation will justify its use. Even in Class A cable the utilization of silicone cable by an increased current density over that for conventional Class A cable will in some instances be more economical.

An example is shown in Figure 1 which shows an example of critical lead cable design and a comparison of the space required between two sizes of cable that might be used (#8 AWG cable with silicone rubber insulation and #2 AWG cable with Class A insulation). Figure 2 illustrates comparative current carrying capacity of lead cable insulated with Class H insulation versus lead cable insulated with Class A insulation.

For continuous and reliable service in Class B service, Class F service, and Class H service, silicone rubber insulated lead cable should be used. Keep in mind also that the higher thermal rating of silicone rubber insulation permits higher current density even in Class A service and that in certain special instances it may be desirable to employ silicone rubber for Class A apparatus.

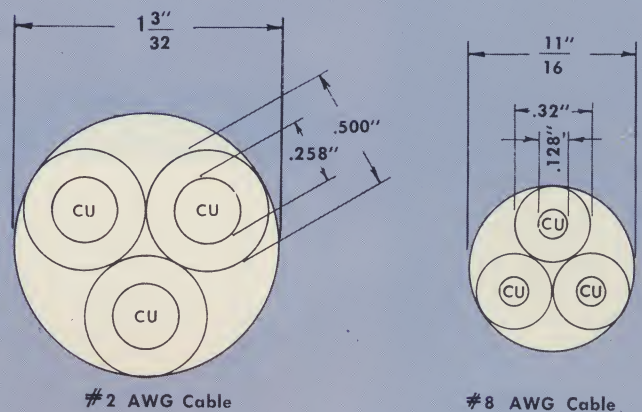
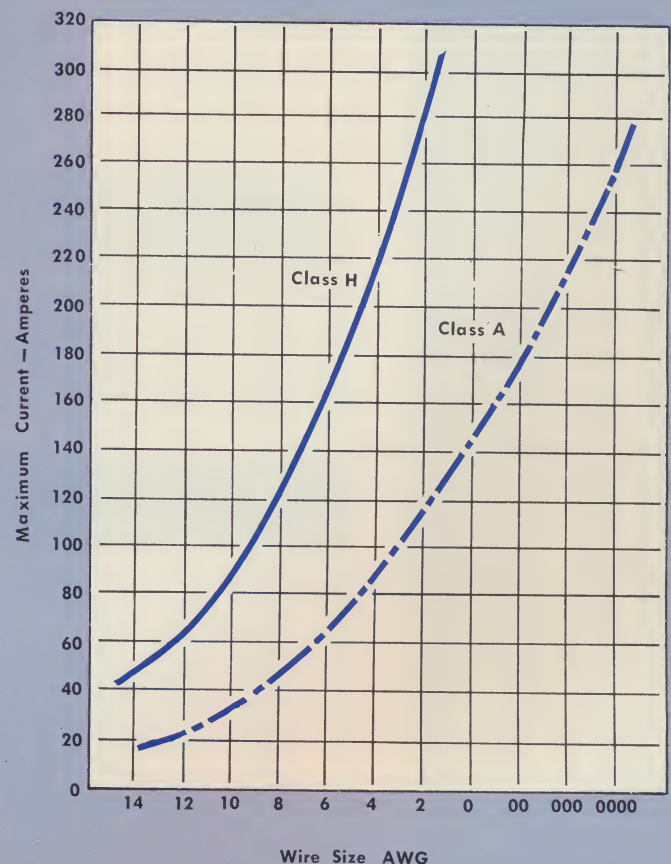


Figure 1

Figure 2



MILITARY WIRE & CABLE

AIRCRAFT WIRE

MIL-W-8777B & MS 25471

WIRE, ELECTRICAL, SILICONE INSULATED, COPPER, 600 VOLT, 200 C
FINISH: BRAID AND LACQUER

CONSTRUCTION

Stranded silver plated conductor; silver plating to ASTM and Government standards; silicone insulation; a glass and dacron braid impregnated with high temperature lacquer; dacron braid and high temperature lacquer.

FEATURES:

Capable of operation from -65°F to 400°F . Flame resistant. Resistant to aircraft hydraulic fluids, lubricants, and fuels. Free stripping, and easily marked with conventional marking equipment.

Ga.	Conductor (AWG)	Net Copper Wt. (Lbs./M Ft.)	Nominal Diameter (Inches)	Nominal Weight (Lbs./M Ft.)
22	19 x 34	2.31	.084	5.20
20	19 x 32	3.68	.094	7.09
18	19 x 30	5.88	.109	10.21
16	19 x 29	7.38	.124	13.18
14	19 x 27	11.72	.140	18.54
12	19 x 25	18.66	.160	27.07
10	7 x 7 x 27	30.16	.196	42.77
8	7 x 19 x 29	50.97	.246	68.60
6	7 x 19 x 27	81.03	.300	106.06
4	7 x 19 x 25	130.40	.356	162.48
2	19 x 35 x 30	204.06	.422	243.46
1	19 x 43 x 30	249.91	.457	292.33
0	19 x 55 x 30	321.26	.527	379.43
00	19 x 70 x 30	407.34	.577	472.36

AIRCRAFT WIRE

MIL-W-8777B & MS 27110

WIRE, ELECTRICAL, SILICONE INSULATED, COPPER, 600 VOLT, 200 C
FINISH: TEFLON JACKET

CONSTRUCTION:

Stranded silver plated conductor; silver plating to ASTM and Government standards; silicone insulation; a glass braid impregnated with silicone lacquer; Teflon[†] 100 jacket.

FEATURES:

High temperature and abrasion resistant. Extruded Teflon[†] 100 jacket provides excellent solvent, moisture, flame and fungus resistance.

Ga.	Conductor (AWG)	Net Copper Wt. (Lbs./M Ft.)	Nominal Diameter (Inches)	Nominal Weight (Lbs./M Ft.)
22	19 x 34	2.31	.086	6.22
20	19 x 32	3.68	.096	8.19
18	19 x 30	5.88	.108	11.24
16	19 x 29	7.38	.116	13.38
14	19 x 27	11.72	.141	20.27
12	19 x 25	18.66	.160	28.76
10	7 x 7 x 27	30.16	.194	44.22
8	7 x 19 x 29	50.97	.243	71.17
6	7 x 19 x 27	81.03	.292	107.34
4	7 x 19 x 25	130.40	.357	166.36

[†]Registered Trademark, E. I. DuPont de Nemours & Co., Inc.

MILITARY ELECTRONIC HOOK-UP WIRE AND LEAD WIRE

MIL-W-16878

MILITARY WIRE & CABLE

■ TYPE F Plain 600 volts • 200 C

Size Awg. Approx.	No. of Strands	Nom. Diam. Individual Strands (Inches)	Max. Resistance (d.c.) at 25C Ohms/1000 Ft.	Nom. Diam. of Stranded Conductor (Inches)	Max. Diam. Finished Cable (Inches)	Nom. Wt. of Cable (Lb./1000 Ft.)
24	7	.008	26.8	.024	.058	2.45
22	7	.010	16.7	.030	.064	3.38
20	7	.0126	10.5	.038	.072	4.93
20	19	.008	10.5	.040	.072	5.14
18	7	.0159	6.57	.048	.082	7.25
18	19	.010	6.57	.050	.082	7.56
16	19	.0113	4.85	.057	.091	9.50
14	19	.0142	3.05	.071	.121	15.69
12	19	.0179	1.92	.090	.140	23.79

■ TYPE FF Plain 1000 volts • 200 C

24	7	.008	26.8	.024	.089	4.2
22	7	.010	16.7	.030	.095	5.3
20	7	.0126	10.5	.038	.103	7.1
20	19	.008	10.5	.040	.105	7.5
18	7	.0159	6.57	.048	.113	9.7
18	19	.010	6.57	.050	.115	10.2
16	19	.0113	4.85	.057	.122	12.1
14	19	.0142	3.05	.071	.168	21.0
12	19	.0179	1.92	.090	.187	29.8
10	37	.0159	1.24	.111	.208	41.2
8	133	.0111	.726	.170	.290	77.7
6	133	.0142	.444	.215	.333	129.0

■ TYPE F Glass braided 600 volts • 200 C

Size Awg. Approx.	No. of Strands	Nom. Diam. Individual Strands (Inches)	Max. Resistance (d.c.) at 25C Ohms/1000 Ft.	Nom. Diam. of Stranded Conductor (Inches)	Max. Diam. Finished Cable (Inches)	Nom. Wt. of Cable (Lb./1000 Ft.)
24	7	.008	26.8	.024	.075	4.19
22	7	.010	16.7	.030	.081	4.52
20	7	.0126	10.5	.038	.089	6.11
20	19	.008	10.5	.040	.089	6.32
18	7	.0159	6.57	.048	.099	8.54
18	19	.010	6.57	.050	.099	8.85
16	19	.0113	4.85	.057	.108	10.92
14	19	.0142	3.05	.071	.138	17.94
12	19	.0179	1.92	.090	.157	26.37

■ TYPE FF Glass braided 1000 volts • 200 C

22	7	.010	16.7	.030	.112	6.9
20	7	.0126	10.5	.038	.120	8.7
20	19	.008	10.5	.040	.122	9.1
18	7	.0159	6.57	.048	.130	11.5
18	19	.010	6.57	.050	.132	12.0
16	19	.0113	4.85	.057	.139	14.4
14	19	.0142	3.05	.071	.185	24.4
12	19	.0179	1.92	.090	.204	33.7
10	37	.0159	1.24	.111	.225	45.6
8	133	.0111	.726	.170	.307	83.7
6	133	.0142	.444	.215	.350	136.0

TYPE FFW Type FFW is the same as Type FF except that the stranded conductor is sealed against moisture penetration with a silicone paste.

*Available also with silver-plated copper conductor and nickel-clad conductor for extreme high temperature service

CONDUCTOR
Stranded
tinned copper*

INSULATION
Silicone
rubber

CONDUCTOR
Stranded
tinned copper*

INSULATION
Silicone
rubber

BRAID
Glass high-
temperature
finish

CABLES FOR NON-FLEXING SERVICE

HEAT- AND FLAME-RESISTANT TYPES

MIL-C-2194 (Ships)

■ TYPE SSGA

SINGLE CONDUCTOR, SHIPBOARD, GENERAL USE, ARMORED CABLE

SSGA-14 to -800,
inclusive:

Construction is similar to cable at left, except:

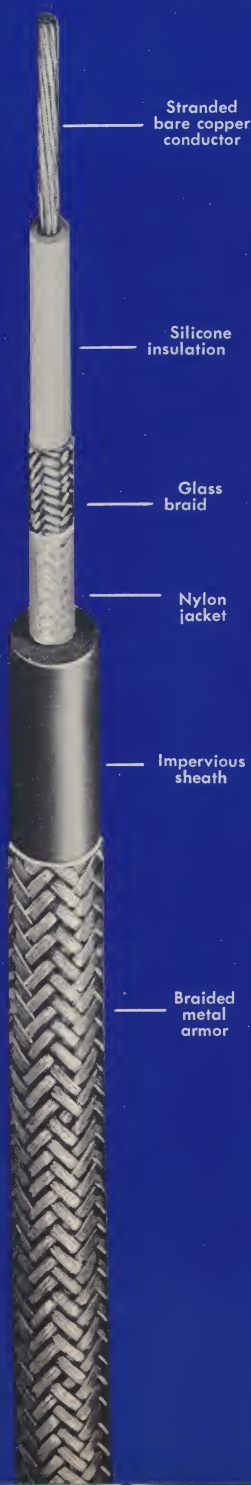
- (1) silicone-treated glass tapes
- (2) suitable binder
- (3) Nylon jacket omitted

SSGA-3 to -9,
inclusive:

COPPER CONDUCTOR

Navy Type No.	Number of Strands	Area (Circular Mils)	Diameter Over Copper Conductor (Inches)	Maximum Over-all Diameter† (Inches)	Approximate Net Wt. (Lb. per 1000 Ft.)
SSGA-3	7	2,828	0.060	0.305	49
SSGA-4	7	4,497	.076	.323	60
SSGA-9	7	9,016	.108	.371	88
SSGA-14	7	14,340	.136	.414	118
SSGA-23	7	22,800	.171	.453	159
SSGA-30	19	30,860	.202	.484	192
SSGA-40	19	38,910	.226	.515	224
SSGA-50	19	49,080	.254	.570	284
SSGA-60	37	60,090	.282	.609	331
SSGA-75	37	75,780	.317	.652	398
SSGA-100	61	99,060	.363	.719	501
SSGA-125	61	124,900	.407	.788	618
SSGA-150	61	157,600	.457	.844	753
SSGA-200	61	198,700	.514	.922	916
SSGA-300	91	296,400	.628	1.051	1,281
SSGA-400	127	413,600	.742	1.168	1,717
SSGA-500	127	521,600	.832	1.290	2,139
SSGA-650	127	657,600	.936	1.421	2,650
SSGA-800	127	829,300	1.050	1.535	3,268
SSGA-1000	127	1,046,000	1.180	1.670	
SSGA-1300	127	1,318,000	1.325	1.880	
SSGA-1600	127	1,662,000	1.485	2.060	
SSGA-2000	127	2,097,000	1.670	2.260	

† Minimum O.D. is 92½% of maximum O.D.



CABLES FOR NON-FLEXING SERVICE

HEAT- AND FLAME-RESISTANT TYPES

MIL-C-2194 (Ships)

■ TYPE DSGA

DOUBLE-CONDUCTOR, SHIPBOARD, GENERAL USE, ARMORED CABLE

DSGA-14 to -800,
inclusive:

Construction is similar to cable at right, except:
(1) silicone-treated glass tapes
(2) suitable binder
(3) Nylon jacket omitted

COPPER CONDUCTOR

Navy Type No.	Number of Strands	Area (Circular Mils)	Diameter Over Copper Conductor (Inches)	Maximum Over-all Diameter† (Inches)	Approximate Net Wt. (Lb. per 1000 Ft.)
DSGA-3	7	2,828	0.060	0.441	94
DSGA-4	7	4,497	.076	.477	114
DSGA-9	7	9,016	.108	.594	176
DSGA-14	7	14,340	.136	.680	278
DSGA-23	7	22,800	.171	.781	391
DSGA-30	19	30,860	.202	.852	486
DSGA-40	19	38,910	.226	.898	566
DSGA-50	19	49,080	.254	.961	665
DSGA-60	37	60,090	.282	1.031	794
DSGA-75	37	75,780	.317	1.124	954
DSGA-100	61	99,060	.363	1.217	1,175
DSGA-125	61	124,900	.407	1.374	1,485
DSGA-150	61	157,600	.457	1.479	1,802
DSGA-200	61	198,700	.514	1.633	2,224
DSGA-250	61	250,500	.577	1.759	2,687
DSGA-300	91	296,400	.628	1.891	3,128
DSGA-400	127	413,600	.742	2.119	4,176

† Minimum O.D. is 92½% of maximum O.D.

■ TYPE TSGA

THREE-CONDUCTOR, SHIPBOARD, GENERAL USE, ARMORED CABLE

TSGA-14 to -800,
inclusive:

Construction is similar to cable at right, except:
(1) silicone-treated glass tapes
(2) suitable binder
(3) Nylon jacket omitted

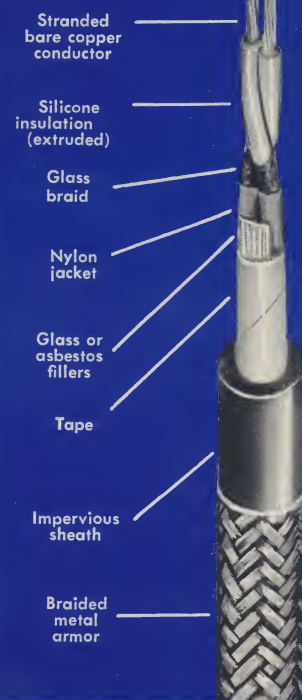
COPPER CONDUCTOR

Navy Type No.	Number of Strands	Area (Circular Mils)	Diameter Over Copper Conductor (Inches)	Maximum Over-all Diameter† (Inches)	Approximate Net Wt. (Lb. per 1000 Ft.)
TSGA-3	7	2,828	0.060	0.461	121
TSGA-4	7	4,497	.076	.499	140
TSGA-9	7	9,016	.108	.625	237
TSGA-14	7	14,340	.136	.718	364
TSGA-23	7	22,800	.171	.812	481
TSGA-30	19	30,860	.202	.902	610
TSGA-40	19	38,910	.226	.950	715
TSGA-50	19	49,080	.254	1.019	852
TSGA-60	37	60,090	.282	1.110	1,019
TSGA-75	37	75,780	.317	1.184	1,226
TSGA-100	61	99,060	.363	1.316	1,555
TSGA-125	61	124,900	.407	1.458	1,935
TSGA-150	61	157,600	.457	1.565	2,337
TSGA-200	61	198,700	.514	1.719	2,923
TSGA-250	61	250,500	.577	1.844	3,493
TSGA-300	91	296,400	.628	2.007	4,150
TSGA-350	91	349,800	.682	2.123	4,794
TSGA-400	127	413,600	.742	2.253	5,537

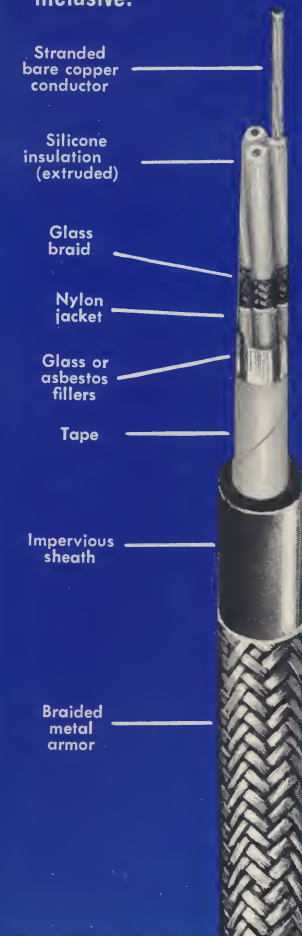
† Minimum O.D. is 92½% of maximum O.D.

MILITARY WIRE & CABLE

DSGA-3 to -9,
inclusive:



TSGA-3 to -9,
inclusive:



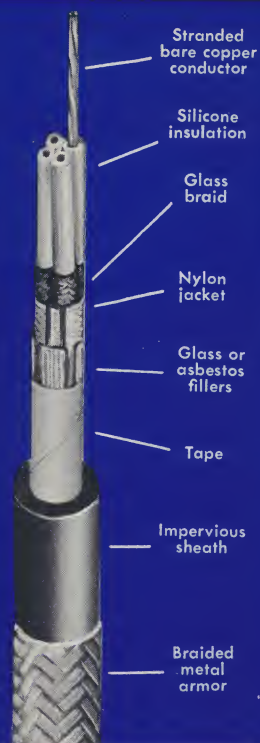
MILITARY WIRE & CABLE

CABLES FOR NON-FLEXING SERVICE

HEAT- AND FLAME-RESISTANT TYPES

■ TYPE FSGA

FOUR-CONDUCTOR, SHIPBOARD, GENERAL USE, ARMORED CABLE



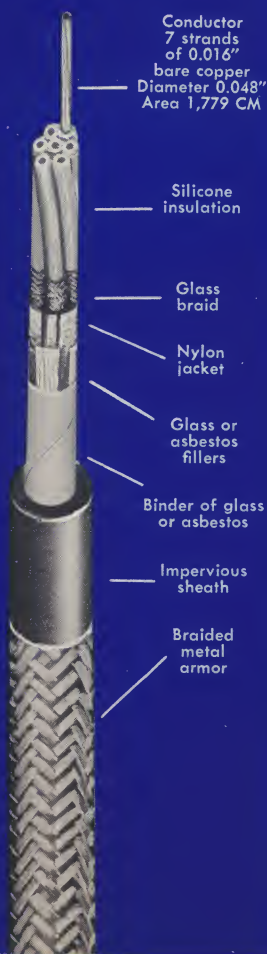
COPPER CONDUCTOR

Navy Type No.	Number of Strands	Area (Circular Mils)	Diameter Over Copper Conductor (Inches)	Maximum Over-all Diameter (Inches)	Approximate Net Wt. Lb. per 1000 Ft.
FSGA-3	7	2,828	0.060	0.497	145
FSGA-4	7	4,497	.076	.563	197
FSGA-9	7	9,016	.108	.680	292
FSGA-23	7	22,800	.171	.890	550
FSGA-50	19	49,080	.254	1.100	925

† Minimum O.D. is 92½% of maximum O.D.

■ TYPE MSCA

MULTIPLE-CONDUCTOR, SHIPBOARD, CONTROL, ARMORED CABLE



COPPER CONDUCTOR

Navy Type No.	Number of Conductors	Maximum Over-all Diameter† (Inches)	Approximate Net Wt. Lb. per 1000 Ft.
MSCA-7	7	0.534	172
MSCA-10	10	.672	260
MSCA-14	14	.718	315
MSCA-19	19	.788	391
MSCA-24	24	.905	493
MSCA-30	30	.951	576
MSCA-37	37	1.022	699
MSCA-44	44	1.134	856
MSCA-61	61	1.270	
MSCA-91	91	1.500	

† Minimum O.D. is 92½% of maximum O.D.

MIL-C-3702 Grade B

CONSTRUCTION:

Nickel plated copper or stainless steel conductors, silicone insulation, reinforcing glass braid, silicone jacket.

Type I Unshielded Wire

Type II Shielded Wire

FEATURES:

Used for service temperature in the range from 450 F to minus 65 F. Silicone insulation provides dielectric strength and low capacitance. Construction exceeds high temperature requirements of specification.

Class 1 Nickel plated copper,
19 x No. 29 AWG

Class 3 Corrosion-resistant steel conductor
7 x 0.013

Cable Designation	Type	Grade	Class	Size
3702-5MS	I	B	3	5MM
3702-5MC	I	B	1	5MM
3702-7MC	I	B	1	7MM
3702-7MS	I	B	3	7MM
3702-S5MS	II	B	3	5MM
3702-S5MC	II	B	1	5MM
3702-S7MC	II	B	1	7MM
3702-S7MC	II	B	3	7MM

MILITARY WIRE & CABLE

Conductor

Silicone insulation

Glass braid

Silicone jacket

MILITARY SPECIFICATIONS

	MIL-C-2194D	MIL-C-3702 GRADE B	MIL-W-8777B	MIL-W-16878D			MIL-C-23206	
				TYPE F	TYPE FF	TYPE FFW	INS	JACKET
Application	Navy Cable	Ignition Cable	Aircraft Wire	Hook-up Wire	Hook-up Wire	Hook-up Water-Tight Wire	Navy Nuclear Plant	
Temperature Rating	135C	232C	200C	200C	200C	200C	High Ambient Temp.	
Voltage Rating	600V	—	600V	600V	1000V	1000V	600V	
PHYSICAL PROPERTIES								
Original — As Received								
Tensile Strength, psi min.	750		600	700	700	1200	750	800 . n.
Elongation , %, min.	125		75	125	125	450	125	250
Durometer , min.								60 min.
High Temp. Aging								
			6 Hr./232C and 0 ₂ /7 Days 80 C/300#					24 Hr./260C
Tensile Strength, psi			80%—Orig.					600 min.
Elongation , %, min.			60%—Orig.					150 min.

MILITARY SPECIFICATIONS (Cont.)

	MIL-C- 2194D	MIL-C- 3702 GRADE B	MIL-W 8777B	MIL-W-16878D			MIL-C-23206	
				TYPE F	TYPE FF	TYPE FFW	INS	JACKET
ELECTRICAL PROPERTIES								
Original — As Received	3 KV	5MM-37MMF	100/22C	2.2 KV	3 KV	3 KV	700V	3 KV
Capacitance		7MM-33MMF						
1000 Cps, max.		0.2 ma						
Creepage, max.		5MM-30 KV						
Diel. Str., min.								
Hum. Res.	500/15.6C	7MM-34 KV	2-4 KV	4 KV	5 KV	5 KV		
Meg-1000 Ft.		30 KV						
Ins. Flaws								
Ins. Res.								
Meg-1000 Ft.								
Surf. Res., Min.		5/22C	500/25C	500/25C	500/25C	500/15.6C		
		5 Meg-In. at 25C	5 Megohms, Min. ±50%	Change				
High Temp. Aging								
Diel. Str., Min.				2.2 KV	3 KV	3 KV		
PERFORMANCE PROPERTIES								
Original — As Received	250 Scrapes		(See MS25471)					
Abrasion								
Anti-Icing Fluid								
Corona								
Flammability								
	No Elec. Failure. 1 Hr. in 24 In. Burner Flame.	No Phys. Change + Pass. D.S.	(1) 800V/5 Min. (2) B.T.-30" Max. F.T.- 3"/Min. Max. 5 KV	Burning Time — 30 Sec. Max.				
		No Phys. Change + Pass D.S.						
		No Falling Particles						
		F.T.-1/2"/Min., Max.						
		Pass. D.S.						
Flaw Test								
Fungus Resistance								
High Temp. Endurance			Pass D.S., Cold Bend, Oil Absorp.					
High Voltage/High Altitude		No Ins. or Sheath Damage or Corrosion						
Hot Oil Immersion		No Phys. Change + Pass. D.S. + 30% Swell, Max.	Flex, D.S. + 5% Swell, Max.					
Immersion			No Phys. Change, D.S. +5% Swell, Max.					
Life Cycle		Pass Flex, Immersion, High Altitude	Pass Bend, Pass D.S., No Pitting					
Low Temp.		24 Hr./-54C + Flex + D.S.	4 Hr./-55C + Flex + D.S.	4 Hr./-54C + Flex + D.S.	Flex at -20C.	No Damage		
Smoke			No Smoking 15 Min./210C CRD. Temp.					
Solderability				1/8 Inch Shrinkage, Max.				
Tensile Load		55 Lbs.						
Water Tightness	1 Cu. In., Max. (6 Hr./25 psi)						1 Cu. In., Max. (6 Hr./25 psi)	
HIGH TEMPERATURE AGING								
96 Hr./250C								
Shrinkage				1/8 Inch Shrinkage, Max.				
Watertightness						Zero Water Leakage		

The specification requirements are shown for information only and are based on the most recent data available to General Electric Silicone Products Department. No guarantee is made that this data is current or accurate. It is recommended that the actual specification be reviewed.

PROPERTIES OF G-E SILICONE RUBBER COMPOUNDS

The following data provides information on standard silicone rubber compounds readily available to manufacturers of wire, cable, and insulating tapes. Many fabricators of electrical components mix their own compounds from silicone rubber gums supplied by General Electric Silicone Products Department. No attempt is made to list these gums or the formulations in which they may be employed. For information on the performance of silicone rubber insulation in unusually severe or unique conditions it is suggested that you refer to one of the wire and cable manufacturers listed on page 3 of this brochure, or to the General Electric Silicone Products Department, Waterford, New York.

The following pages show only a few of the many silicone materials that have been developed to serve you. For information on other silicone materials, please contact the nearest sales office listed on page 39.

DATA ON ELECTRICAL AND PHYSICAL CHARACTERISTICS ARE TYPICAL AND SHOULD NOT BE USED IN PREPARING SPECIFICATIONS. FOR SPECIFICATION VALUES, PLEASE CONSULT YOUR PREFERRED WIRE AND CABLE SUPPLIER OR GENERAL ELECTRIC SILICONE PRODUCTS DEPARTMENT, WATERFORD, NEW YORK.

COATING COMPOUNDS— CLASS 100

Class 100 silicone rubber compounds are excellent high temperature insulators. They resist moisture, ozone and corona attack. Class 100 also is water repellent and weather resistant.

These silicone rubber compounds are used primarily for coating glass or organic fabrics for high or low temperature electrical applications. Typical examples include electrical tapes for cable construction, generators, and motors.

Silicone rubber compounds included in Class 100 are SE-100 and SE-1010.

SE-100

APPLICATIONS

Used to coat glass or organic fabrics for such high or low temperature applications as electrical insulating tape and glass sleeving.

SPECIFICATIONS

Properly fabricated on glass cloth SE-100 is used in constructions which meet MIL-C-2194D. SE-100 coated glass cloth has also been successfully tested against MIL-E-5272A to demonstrate its resistance to fungus.

TYPICAL PROPERTIES

PHYSICAL PROPERTIES	
Thickness of Coated Cloth, in.	0.010
Weight per Square Yard, lbs.	0.385
Tensile Strength, pi	
Lengthwise	150
Crosswise	125
Coefficient of Thermal Expansion ⁽¹⁾ 25-250C, in/in°C	+2.6 x 10 ⁻⁴
Heat Resistance	
800 Hrs./250C	No appreciable change in dielectric strength and good physical properties still exist.
200 Hrs./315C	
Low Temperature Flexibility (-60C)	Passes bend over 1/8 inch mandrel.
CHEMICAL PROPERTIES	
Moisture Absorption (96 Hrs. over CaCl ₂ then 96 Hrs./96% RH)	0.11%
Water Absorption (96 Hrs. over CaCl ₂ then 96 Hrs. in H ₂ O at 23C)	0.85%
ELECTRICAL PROPERTIES	
Dielectric Strength (V/M) (1/4 in. Electrodes IPCEA Method)	
25C	1200-1400
25C (After 96 Hrs./96% RH)	1000-1200
85C	1200-1400

ELECTRICAL PROPERTIES			
Temperature	Dielectric Strength ⁽²⁾	Power Factor ⁽³⁾	
25C	1050 vpm	0.85%	
50C	1050 vpm	0.85%	
75C	1010 vpm	0.95%	
100C	1100 vpm	1.25%	
125C	1100 vpm	1.50%	
150C	1050 vpm	2.20%	
200C	1050 vpm	3.35%	
250C		4.50%	
Oil Resistance — 15 min. in 10C Oil		100C	150C
Short Time Dielectric Strength (V/M)		1000-1350	1050-1400
Thickness (mils)		13.7 - 14.7	11.2 - 11.8
Silicone Film (condition)		No change	No change
Power Factor vs. Frequency			
Frequency	Power Factor	Dielectric Constant	
60 cycles	0.85	3.4	
1 KC	0.63	3.2	
10 KC	0.65	3.2	
100 KC	0.60	3.1	
1 MC	0.62	3.0	
80 MC	0.50	2.8	

(1) ASTM slabs oven cured 16 Hrs./250C.

(2) Tested at 60 cycles using 2" diameter ASTM Brass electrodes with a voltage rise of 1 KV per second.

(3) 60 cycles power factor after 48 Hrs./50% R.H.

SE-1010

APPLICATIONS

SE-1010 is a silicone rubber compound designed for electrical applications requiring a high strength coated stock. It can be used to fabricate supported or unsupported tapes by a variety of techniques.

TYPICAL PROPERTIES

PHYSICAL PROPERTIES		
ASTM Slabs	Oven Cure	
	1 Hr./300F	24 Hrs./480F
Color	Red	Red
Hardness, Shore A	50	60
Tensile Strength, psi	1200	900
Elongation, %	560	340
Tear Strength, Die B, pi	105	75
On Glass Cloth ⁽¹⁾	Uncured Tape	Semi-Cured Tape
Thickness	20 mils	20 mils
Bond Strength	18-20 lbs./in.	18-20 lbs./in.
Tear Strength, Die B, pi	900	900
ELECTRICAL PROPERTIES		
	40 Mil Slab ⁽²⁾	60 Mil Laminate ⁽³⁾
Electric Strength, vpm (1/4 in. electrodes, 0.5 KV/sec.)		
23C	560	590
200C	460	470
23C (after 96 Hrs./23C/96% RH)	570	490
23C (after 168 Hrs./250C)	680	640
ELECTRICAL PROPERTIES		
	40 Mil Slab ⁽²⁾	60 Mil Laminate ⁽³⁾
Power Factor, 60 cps		
23C	0.0015	0.002
200C	0.005	0.007
23C (after 96 Hrs./23C/96% RH)	0.0025	0.006
23C (after 168 Hrs./250C)	0.0007	0.0006
Dielectric Constant, 60 cps		
23C	2.9	2.9
200C	2.6	2.7
23C (after 96 Hrs./23C/96% RH)	2.9	3.5
23C (after 168 Hrs./250C)	3.1	3.5
Volume Resistivity, ohm-cm		
23C	1.6×10^{16}	2.0×10^{16}
200C	7.8×10^{12}	5.0×10^{12}
23C (after 96 Hrs./23C/96% RH)	4.1×10^{16}	4.0×10^{15}
23C (after 168 Hrs./250C)	2.8×10^{16}	1.8×10^{16}

⁽¹⁾ ECC-128 Glass Cloth primed with 81781 and SE-1010 Dispersion, press cured 5-10 minutes at 150C.

⁽²⁾ Cured 1 Hr./150C and 4 Hrs./200C.

⁽³⁾ Laminate of 3-20 mil Glass Supported Calendered Tapes, cured 1 Hr./150C and 4 Hrs./200C.

WIRE AND CABLE INSULATION — CLASS 900

Class 900 silicone rubber has an outstanding combination of physical and electrical properties which make it particularly suitable for extruded wire and cable insulation. It maintains insulating properties at elevated temperatures and, in addition, has resistance to moisture and ozone. Should this compound burn, the resultant ash continues to insulate.

Extruded on wire and cable, Class 900 rubber serves as electrical insulation in many military and commercial applications such as aircraft wire, ignition wire, Navy cable, power cable, communication and control cable, motor lead wire (Class B, F and H equipment), fixture and appliance wire, heater and defroster wire.

Silicone rubber compounds included in Class 900 are:

SE-975	SE-9014	SE-9016
SE-9011	SE-9015	SE-565
SE-9029	SE-9032	SE-9035
SE-9036		

SE-975 APPLICATIONS

SE-975 is recognized as the standard for premium quality extruded insulation for commercial power and control cable. With the best electrical properties of commercially available silicone rubber compounds, SE-975 provides the toughness and long-term heat-aging resistance required of high quality wire and cable insulation. In addition to commercial wire and cable applications requiring the best silicone rubber insulation, SE-975 is recommended for the insulation of aircraft wire, electronic and lead wire, ignition cable, special purpose nuclear cables, and single conductor and multiconductor cables for the missile and aerospace industry.

SPECIFICATIONS

Properly fabricated, SE-975 will meet MIL-C-3702, MIL-W-8777, MIL-W-16878, MIL-C-23206, C.S.A. Type SEW, U.L. Class 22, and U.L. Type SA.

SE-9011 APPLICATIONS

SE-9011 is a silicone rubber extrusion compound with excellent physical and electrical properties. Offering significant processing advantages to the fabricator, it retains its non-milling characteristics for three months, and can be used in all equipment and dies designed for extrusion of conventional silicone rubber. SE-9011 will meet Underwriters' Laboratories' requirements for silicone rubber insulated fixture wire. It is designed for use as extruded insula-

tion in such applications as commercial power and control cable, fixture wire, motor and apparatus lead wire, and other commercial and military wire and cable applications.

SPECIFICATIONS

Properly fabricated, SE-9011 will meet MIL-C-3702, MIL-W-8777, MIL-W-16878, C.S.A. Type SEW, U.L. Class 22 and U.L. Type SA.

SE-9014

APPLICATIONS

SE-9014 is a silicone rubber compound designed for extrusion as a wire and cable insulation and jacket. It is characterized by high tensile strength, elongation, and tear strength. The low modulus of SE-9014 remains stable even under conditions of extended storage at elevated temperatures and under service conditions when fabricated parts are exposed to severe temperature fluctuations.

SE-9014 combines optimum physical and electrical properties with stable low modulus characteristics. It is ideally suited for applications such as sonobuoys compliance cable.

SE-9015

APPLICATIONS

SE-9015 is designed for applications requiring a tough, abrasion and tear resistant insulation with self-extinguishing flame resistant characteristics. Recommended to meet specification MIL-W-16878, Types F, FF, and FFW, with or without glass braid, SE-9015 may be used as extruded insulation on braidless lead wire, fixture wire, motor and apparatus lead wire, and in other commercial and military applications. As the jacket of multiconductor control cable, it provides a balanced combination of toughness, abrasion resistance, tear resistance, flame resistance, radiation resistance, and flexibility.

SPECIFICATIONS

Properly fabricated, SE-9015 will meet MIL-W-16878, Types F, FF, and FFW, with or without glass braid.

SE-9016

APPLICATIONS

SE-9016 is a silicone rubber compound specifically formulated for use as a high temperature resistant, extruded cable sheath. It combines excellent heat resistance and excellent physical properties with good processing characteristics.

SPECIFICATIONS

SE-9016 is recommended for use as a sheath for cable produced under specification MIL-C-23206.

SE-565

APPLICATIONS

SE-565 is a high strength, extreme low temperature silicone rubber compound. With good electrical properties, excellent tensile strength, elongation, and tear resistance, SE-565 is

used primarily as a jacket stock or as specialty insulation.

SPECIFICATIONS

Properly fabricated, SE-565 will meet MIL-R-5847D, Class III, 60 durometer or AMS-3346.

SE-9029

APPLICATIONS and SPECIFICATIONS

SE-9029 is designed for applications requiring a tough, abrasion and tear resistant insulation with self-extinguishing flame resistant characteristics. Recommended to meet specification MIL-W-16878, Types F and FF, with or without glass braid, SE-9029 may be used as extruded insulation on braidless lead wire, fixture wire, motor and apparatus lead wire, and in other commercial and military applications. As the jacket of multi-conductor control cable, it provides a balanced combination of toughness, abrasion resistance, tear resistance, flame resistance, radiation resistance, and flexibility. The modulus of SE-9029 is somewhat higher than the modulus of SE-9015 so that SE-9029 may prove more adaptable to automatic stripping devices.

SE-9032

APPLICATIONS and SPECIFICATIONS

SE-9032 has been specially formulated for applications requiring a hard, tough silicone rubber insulation which is capable of withstanding considerable mechanical abuse. The extruded surface is firm and smooth and exhibits good resistance to deformation and compression cut-through.

SE-9032 can be processed in very thin insulation wall thicknesses (10 mils and below). This characteristic will permit the design of smaller diameter wire and cable constructions with resultant savings in space and weight. Design engineers will also appreciate its flame-resistance which will enable insulated wire to pass both Underwriters' Laboratories' and MIL-W-16878 flame tests.

SE-9035

APPLICATIONS and SPECIFICATIONS

SE-9035 has been designed for applications requiring insulation with an unsurpassed combination of physical, electrical and heat-aging characteristics. Electrical properties, in particular, are superior to any other commercially available silicone rubber compound. High insulation resistance and dielectric strength are combined with low dielectric constant and a power factor that remains below 0.0005 over a frequency range of 60 cycles to 10^6 cycles and at temperatures up to 150 degrees Centigrade.

SE-9036

APPLICATIONS and SPECIFICATIONS

SE-9036 is a neutral colored, general purpose compound which will pass the standard Underwriters' Laboratories vertical flame test and the MIL-W-16878 flame test even when applied to small conductors and when used without flame-resistant exterior braids, coverings, or lacquers.

COMPOUND DATA FOR SILICONE RUBBER WIRE

COMPOUND	SE-975	SE-9011	SE-9014	SE-9015	SE-9016	SE-565
Specific Gravity	1.20	1.29	1.15	1.20	1.17	1.22
Color	White	White	Black	Dark Gray	Red	Gray
CV/HAV (on wire)						
Tensile Strength, psi	1200	1100	1300	1600	1200	1600
Elongation, %	450	300	750	700	460	700
Press Cure 10 Min./275F (Slabs)						
Hardness, Shore A	55±5	56±5	33±5	51±5	56±5	53±5
Tensile Strength, psi	1150	1050	1300	1400	1200	1550
Elongation, %	450	425	850	775	600	875
Oven Cure 1 Hr./300F (Slabs)						
Hardness, Shore A	60±5	62±5	36±5	53±5	62±5	55±5
Tensile Strength, psi	1200	1075	1500	1425	1200	1600
Elongation, %	425	375	780	740	500	850
Tear Strength, Die B, pi	125	100	140	220	130	220
Oven Cure 24 Hrs./300F (Slabs)						
Hardness, Shore A	63±5	64±5	38±5	55±5	64±5	58±5
Tensile Strength, psi	1150	1050	1500	1400	1200	1500
Elongation, %	375	350	750	700	460	750
Tear Strength, Die B, pi	120	90	135	210	120	210

PHYSICAL PROPERTIES AFTER HEAT AGING

Hear Aging 24 Hrs./480F (Slabs)						
Hardness, Shore A	67±5	67±5	45±5	65±5	71±5	60±5
Tensile Strength, psi	900	900	900	725	1050	1000
Elongation, %	250	240	500	270	270	300
Heat Aging 96 Hrs./480F (Slabs)						
Hardness, Shore A	68±5	68±5	53±5	70±5	76±5	65±5
Tensile Strength, psi	800	750	750	600	850	800
Elongation, %	200	190	300	200	150	200
Heat Aging 60 Days/410F (Slabs)						
Hardness, Shore A	73±5	72±5	57±5	75±5	76±5	75±5
Tensile Strength, psi	750	750	850	600	800	750
Elongation, %	200	125	300	150	140	180

ELECTRICAL PROPERTIES¹

Volume Resistivity, ohm-cm	5 x 10 ¹⁵	4 x 10 ¹⁵	1.3 x 10 ¹⁵	5 x 10 ¹⁵	4 x 10 ¹⁵	5 x 10 ¹⁵
Electric Strength, volts/mil	650	650	700	575	700	550
Dielectric Constant, 60 cps	3.0	3.3	3.0	3.2	3.1	3.15
Power Factor, 60 cps	0.001	0.002	0.002	0.001	0.003	0.001

WATER ABSORPTION²

70 Hrs. in H ₂ O at 212F						
Hardness Change, Points	+3	+3	+1	+1	+5	+1
Volume Change, %	-1	-1	+1	+1	0	+1
Weight Change, %	0	0	+2	+2	0	+2
168 Hrs. in H ₂ O at 158F						
Hardness Change, Points	+2	+2	+2	+2	+8	+2
Volume Change, %	0	0	0	0	0	0
Weight Change, %	0	0	0	0	0	0
Corrected Water Absorption, mg/in ²	+6	+6	+6	+7	+6	+7
Water Extractables, mg/in ²	+3	+3	+3	+3	+3	+3

ACCELERATED WATER ABSORPTION²

Electrical Method ³		
Increase in Capacitance, Max. %		
1 to 14 days	<1.0	<2.0
7 to 14 days	<1.0	<1.0
Stability Factor 14 days in 75C water	<1.0	<1.0
Gravimetric Method		
Water Absorption, mg/in ²	<10.0	<10.0

SPECIFICATIONS

The properties shown in this data book have been determined in our laboratories and are typical of the product. However, a reasonable degree of variation will occur in commercially-produced material. The typical values shown here should not be used as a basis for specifications. For assistance and recommendations in the preparation of specifications, please contact the Silicone Products Department at Waterford, New York.

AND CABLE INSULATION

SE-9029	SE-9032	SE-9035	SE-9036
1.20 Gray	1.38 Off-white	1.16 Clear	1.38 Off-white
1600	1200	1400	800
450	170	400	300
50±5	83±5	53±5	60±5
1550	1150	1350	900
600	250	520	500
50±5	90±5 *	55±5	65±5
1600	1350	1500	900
500	190	470	400
160	140	100	100
55±5		57±5	67±5
1600		1400	875
450		450	350
150		100	90

60±5	90±5	60±5	70±5
800	975	900	750
200	70	300	180
65±5	91±5	65±5	75±5
650	900	850	700
180	40	270	110
70±5		70±5	80±5
600		900	900
150		270	100

1 x 10 ¹⁶	1 x 10 ¹⁴	2 x 10 ¹⁶	2 x 10 ¹⁵
575	600	680	650
3.1	3.6	2.96	3.3
0.002	0.01	0.0004	0.006

+1	+2	+2	+3
+1	-1	0	-1
+3	-0.5	0	-1
+2	0	+2	+2
0	0	0	+1
0	+0.3	0	+1
+8	+5.7	+3	+9
+4	+4.0	+2	+4

FOR MORE INFORMATION ON GENERAL
ELECTRIC SILICONE RUBBER COMPOUNDS
CONTACT THE SALES OFFICE NEAREST YOU.

CALIFORNIA

Downey 90240
8555 East Florence Ave.
213-773-3144
213-773-3277
San Francisco 94119
1201 Bryant St.
415-863-4000
Ext. 204

CONNECTICUT

Bridgeport 06602
1285 Boston Avenue
203-334-1012

D. C.

Washington 20005
777 14th St. N.W.
202-393-3600

FLORIDA

Jacksonville 32207
1914 Beachway Rd.
305-359-5053

GEORGIA

Atlanta 30302
1860 Peachtree Rd., N.W.
404-876-2451

ILLINOIS

Chicago 60680
840 South Canal St.
312-663-3717

INDIANA

Indianapolis 46207
3750 N. Meridian St.
317-923-7221

MASSACHUSETTS

Boston 02135
145 North Beacon Street
617-254-5316

MICHIGAN

Oak Park 42837
21590 Greenfield Road
313-548-6005

MINNESOTA

(Minneapolis) St. Paul 55104
540 North Fairview Ave.
612-645-2765

MISSOURI

St. Louis 63132
1530 Fairview Ave.
314-429-6930

NEW JERSEY

Newark 07108
254 Elizabeth Avenue
201-243-3662

NEW YORK

Waterford 12188
518-237-3330
Ext. 203, 213
Schenectady 12305
518-374-2211
Ext. 5-4645
New York 10022
570 Lexington Ave.
212-751-1311
Ext. 3465
Buffalo 14211
1495 Fillmore Ave.
716-892-8000
Ext. 255

NORTH CAROLINA

Greensboro 27408
1844 Pembroke Road
919-273-2835

OHIO

Cleveland 44109
1503 Brookpark Road
216-749-2700

Dayton 45402
118 West First St.
513-223-7151

PENNSYLVANIA

Drexel Hill 19026
5050 State Road
215-259-2131
Homestead 15120
Buttermilk Hollow Road
Box 308
412-466-6700
462-7400

TEXAS

Dallas 75235
6500 Cedar Springs
214-351-3725
Houston 77006
3100 Richmond Ave.
713-529-3128

WASHINGTON

Seattle 98111
710 Second Ave.
206-624-8300

IN CANADA

Canadian General Electric
Company, Ltd.
940 Lansdowne Avenue,
Toronto
416-534-6511

FOR EXPORT

International General
Electric Company
New York 16,
159 Madison Ave.
212-751-1311

¹ Tests conducted at 77F and 50% R.H. on .040" slabs cured 1 Hr./300F.

² ASTM Slabs Cured 24 Hrs./300F.

³ IPCEA S-19-8; par. 6.9.2.4, EM-60, except 75C water.

* 3 Hrs./300F.

GENERAL  ELECTRIC

SILICONE PRODUCTS DEPARTMENT

WATERFORD, NEW YORK